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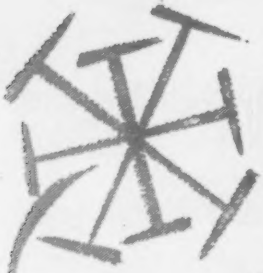

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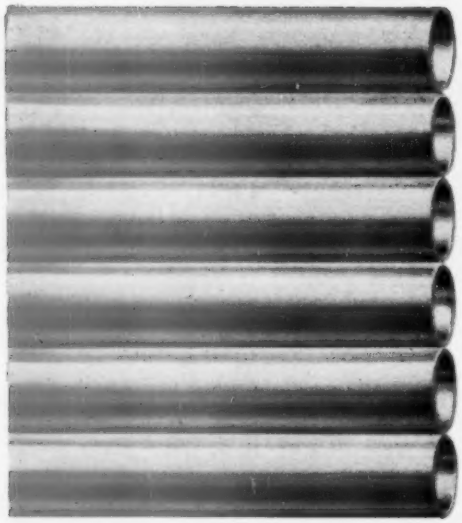

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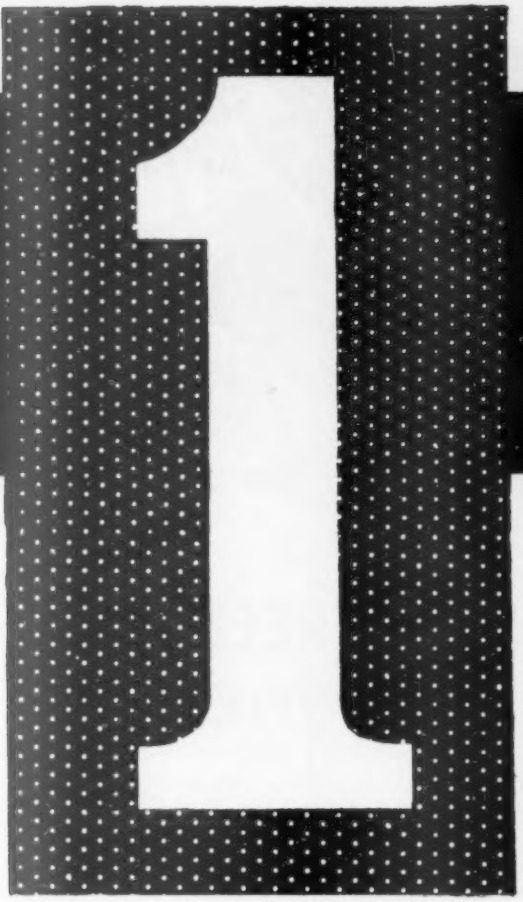
1/12 TO 1/4 H.P.

THE HIGH-SPEED PANCAKE



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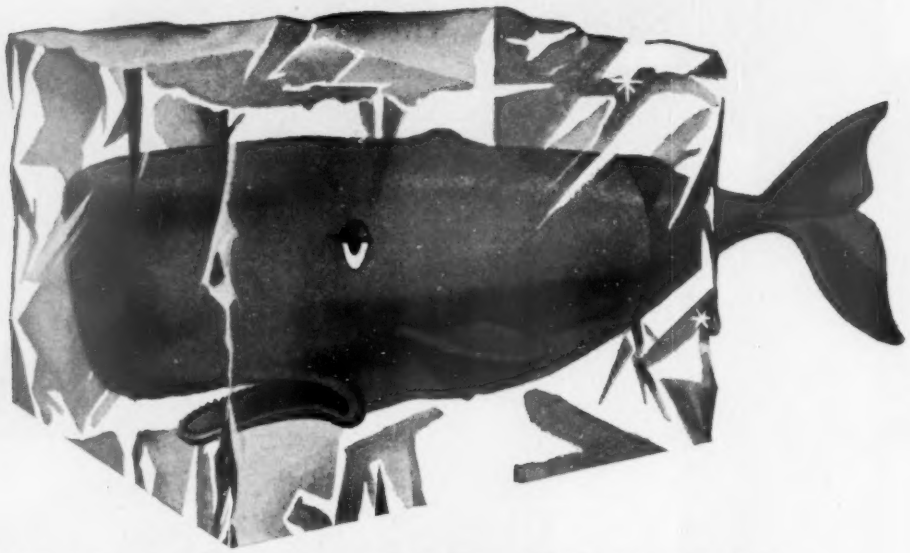

WILLIAMS FASTER FREEZING

makes a whale of a difference

Williams Plate Freezers *are* being used for whale meat, but, nearer home, these double-quick freezers are making a whale of difference to shrimps, fish, peas, fruit and every other kind of frozen food, too. The smaller ice crystals produced by the faster freezing of Williams Direct Conduction Plate Freezers means better flavour, retention of nutrient value and greater production capacity—that's money, commercially speaking. Write for fuller details and find out which type of Williams Double Contact Alloy Plate Freezer, with hourly capacities from 200 to 5000 lbs., could best be tailored to your organisation.

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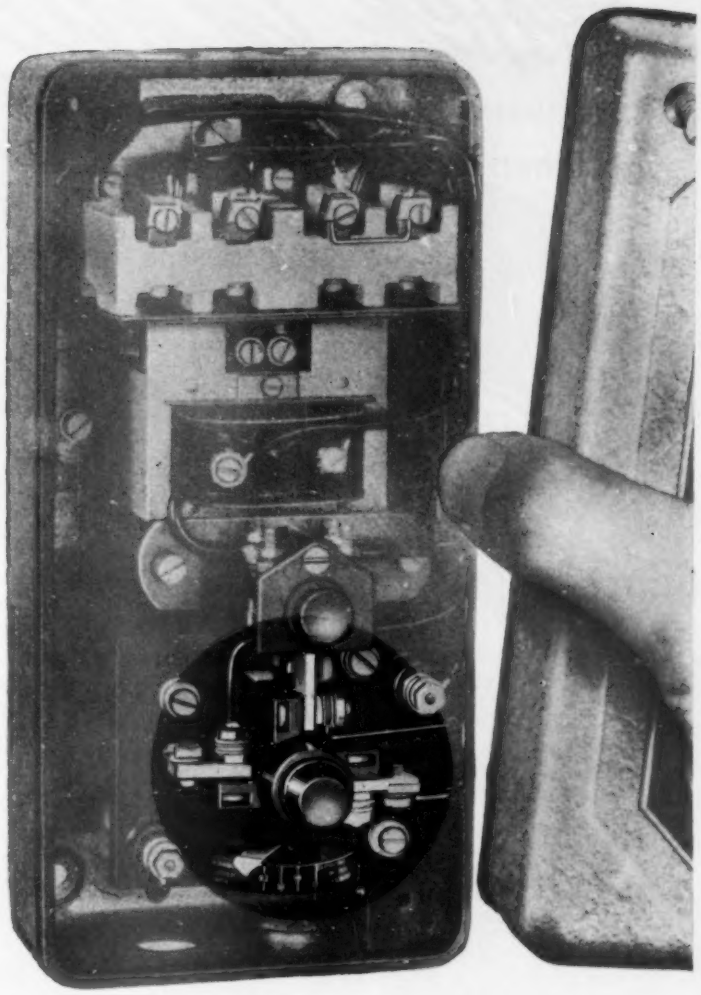
overload protection is not enough

DUPAR DOUBLE SAFETY is here

in the OUTSTANDING TFK STARTER



The DUPAR TFK is the ONLY Starter in its class guaranteeing positive motor protection against single phasing and overloading by means of the exclusive DUPAR ET Protector. Fit DUPAR TFK for complete safety and long trouble-free life on the heaviest of duties.

- Range: ¼-7½ h.p. 3-phase a.c.
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- Sustained high performance satisfies the most critical installations.

Specification leaflet 202E gives full details — ask for your copy now!

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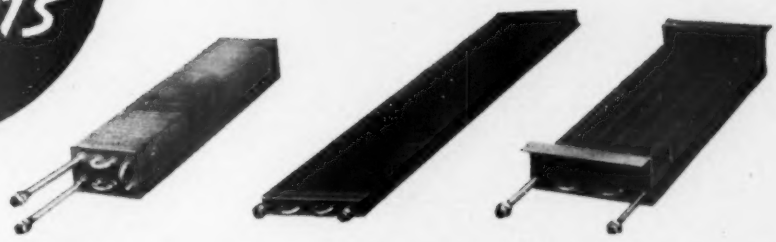

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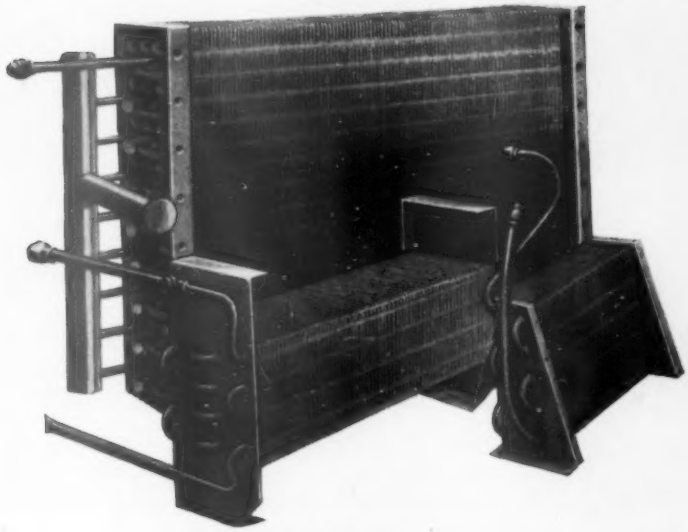
FOR :—DISPLAY CASE, COMMERCIAL and INDUSTRIAL APPLICATIONS



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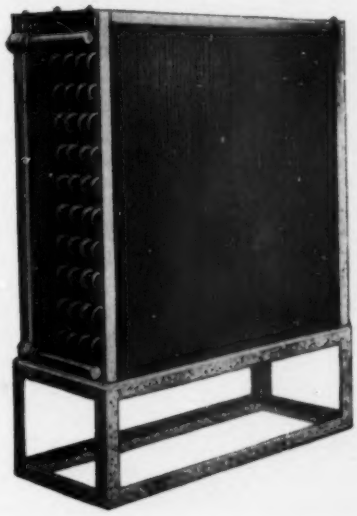

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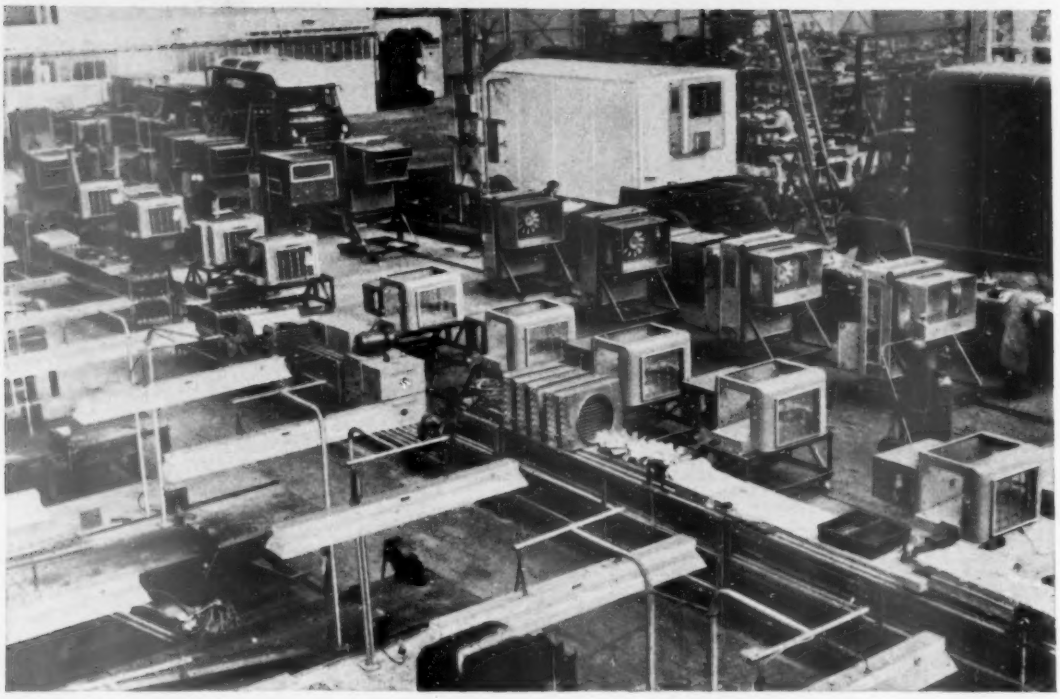
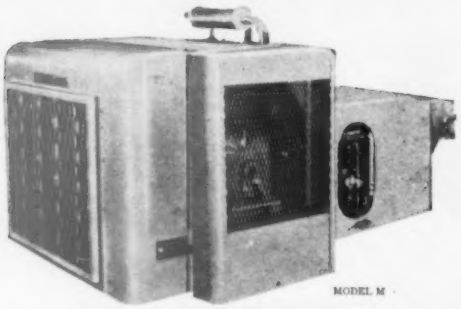


Showing production line of Thermo King refrigeration units Models KL and M. These can be installed in straight trucks or trailers and will maintain automatically the temperature required for frozen foods, dairy products, meat, fish, etc.



MODEL M

Increased demand and production in Great Britain of the world-renowned Thermo King refrigeration units have already made possible substantial price reductions. Thermo King units are built with 50% British components, and this percentage will be increased in the near future.

HAWKER SIDDELEY (HAMBLE) LTD.

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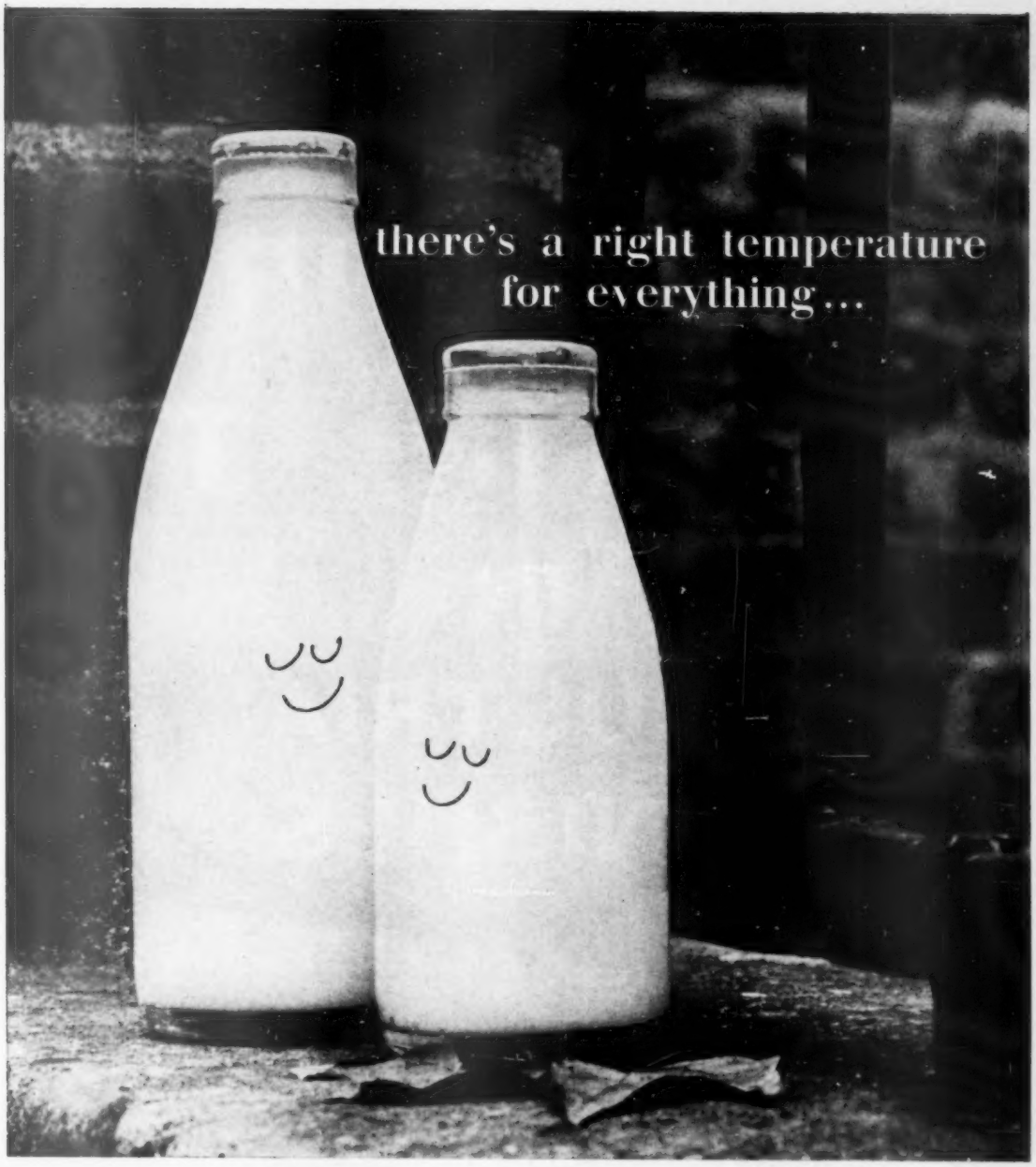

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maintained by Teddington controls

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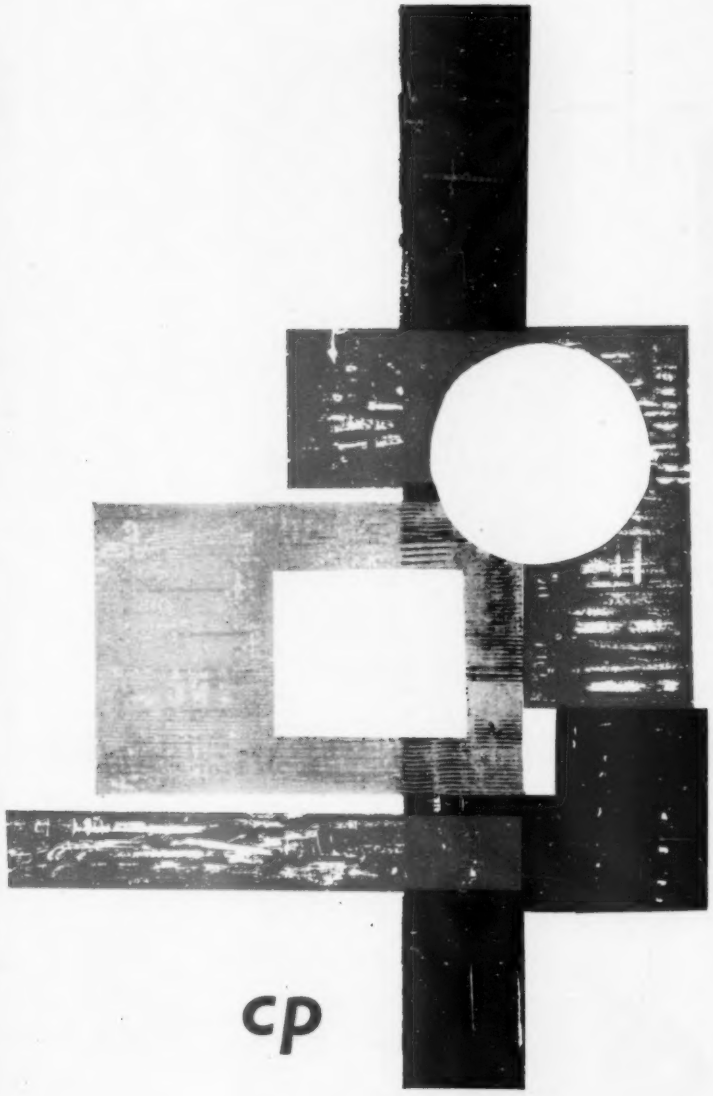

At home, at work, in transport and even on holiday—everywhere IRIDON Plastics are in evidence. On every hand—in every hand—IRIDON Plastics are replacing more traditional materials. Extensive research produces more and more reasons why they are being used. Mechanical reasons, chemical reasons, dielectric reasons, economic reasons.

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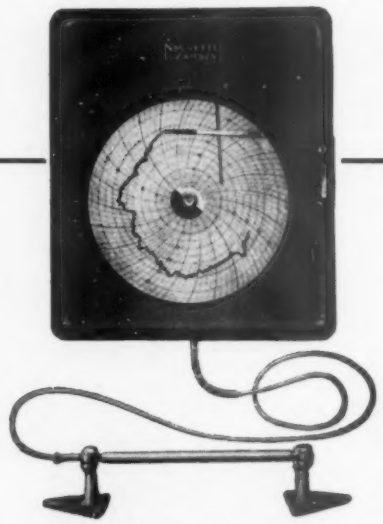
Porcelain Thermometer for Cold Stores

Metal Scale Thermometer for Refrigerated Chambers

Brine Pipe Thermometers

Dial Thermometer. Standard Type for Cold Stores

Multi-point Resistance Thermometer



"Mersteel" Temperature Recorders. Standard Type for Cold Stores

NEGRETTI & ZAMBRA

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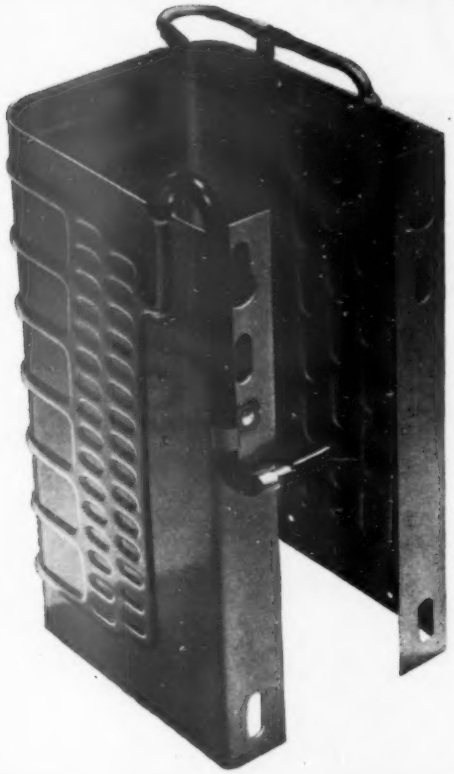
Marston Evaporator Units



Light alloy roll-welded evaporator units offer many advantages: superior performance, light weight, attractive appearance, flexibility of design, competitive prices. A production line specially equipped for the fabrication of these units is operated by Marstons, specialists in heat transfer for sixty years. Why not discuss your design and production problems with them?

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MAR. 292

NEW DESIGN
EXTRA CAPACITY

VENTNOR

The Ventnor cabinet has been designed with the small shop in mind. It will display and store over 600 lb. of frozen foods under ideal low temperature conditions, yet the Ventnor will only occupy 15 sq. ft. of your very valuable floor space—little more than is taken by the average shop counter.

Net capacity 17 cubic feet. Gross capacity 20 cubic feet.

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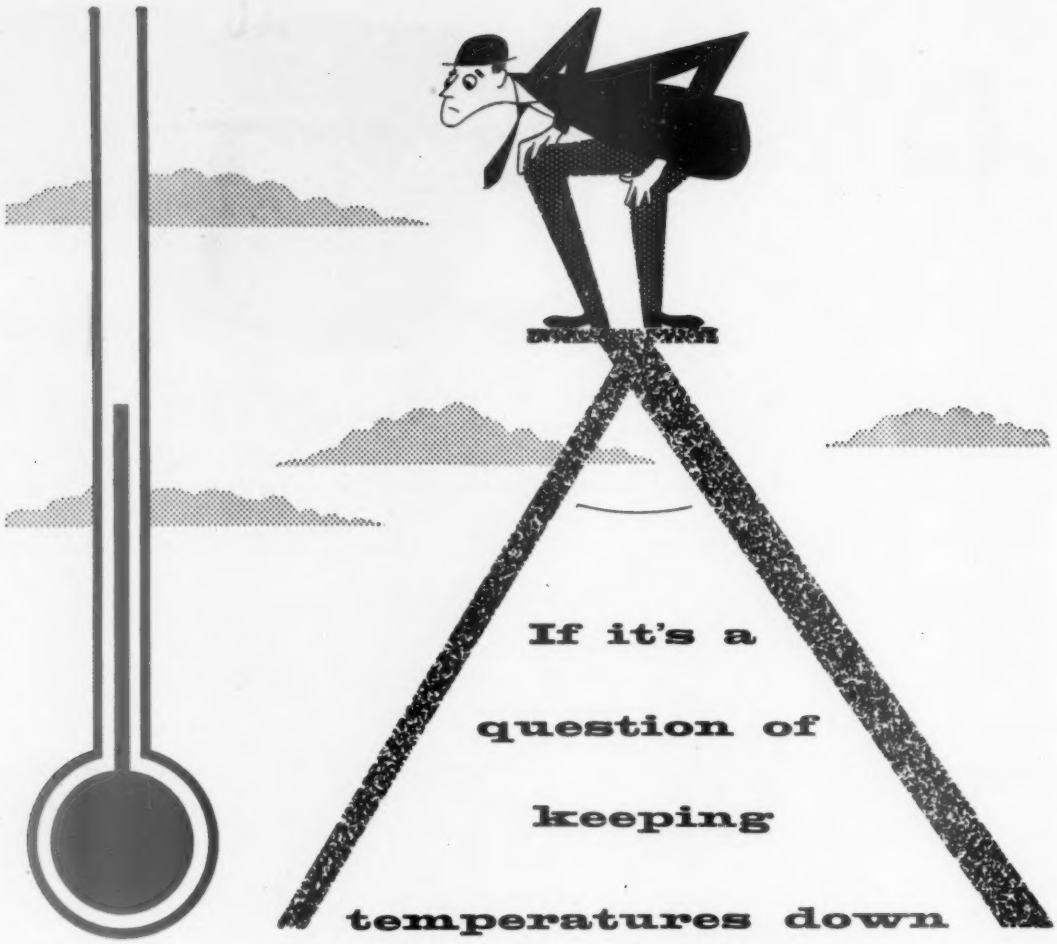

Whenever low temperature insulation is concerned, Newalls are the people to look to. They have a background of over 50 years experience in all kinds of contracts—in cold stores, in cargo and passenger ships, in breweries and creameries — in fact wherever there are refrigerated spaces.
Newalls supply *and* apply low-temperature insulation materials and their service is available through each of eight depots situated throughout the United Kingdom. When the specification calls for a first class job, call in Newalls.

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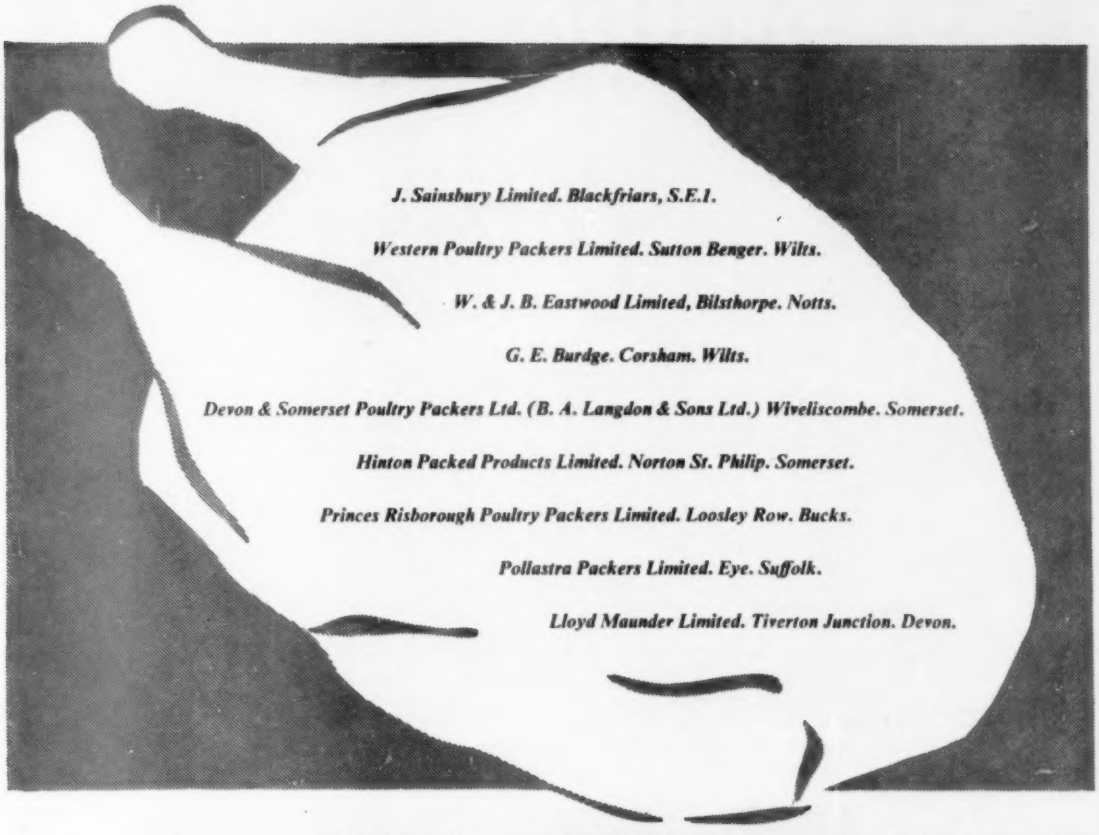

have chosen DOUGLAS QUICK FREEZING PLANT

The DOUGLAS system for QUICK FREEZING poultry
produces a bird of the best possible quality and colour.
It has been specially designed for its purpose and is arranged to fit readily
into the production line.
It is adaptable to any layout and can be arranged to take care of
expanding output as production grows.
If you want to know more about the Douglas quick freeze system,
(and Douglas dry rendering plant which converts waste,
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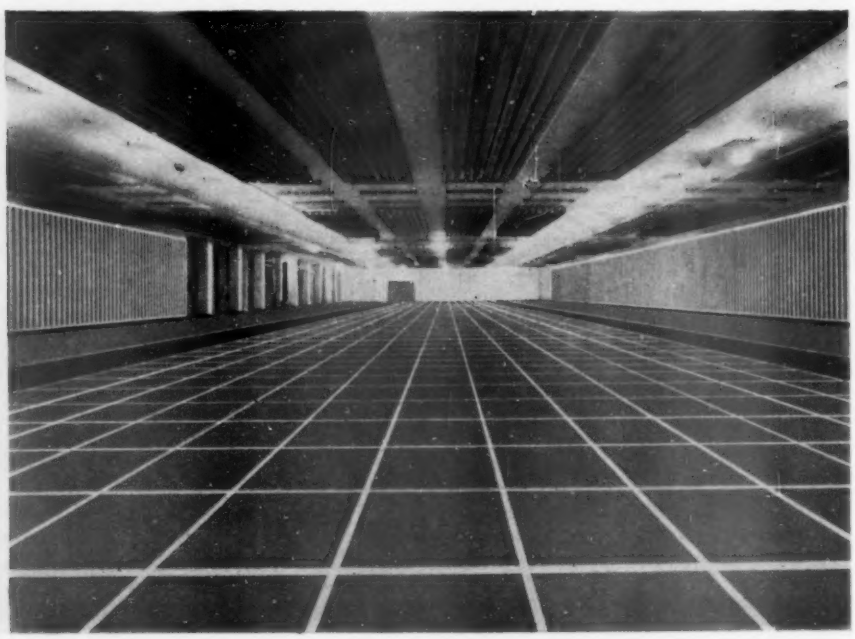
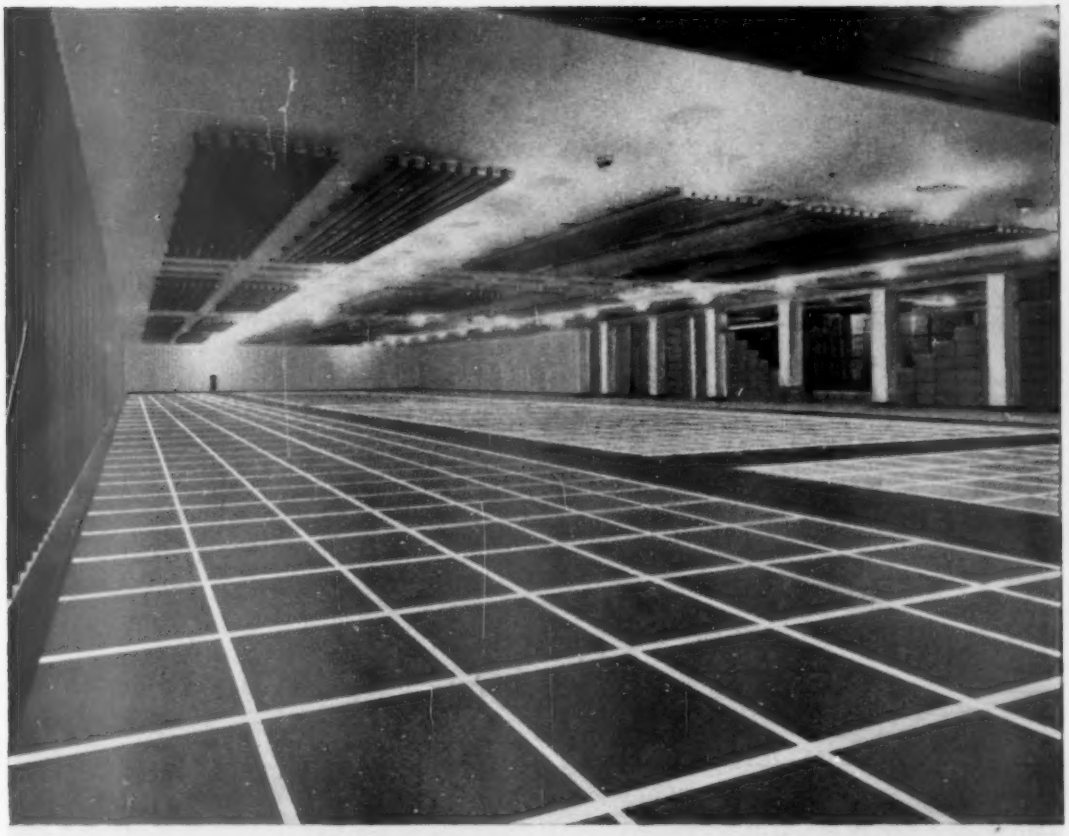
SMITHS COMPLETE EUROPE'S LARGEST COLD STORE

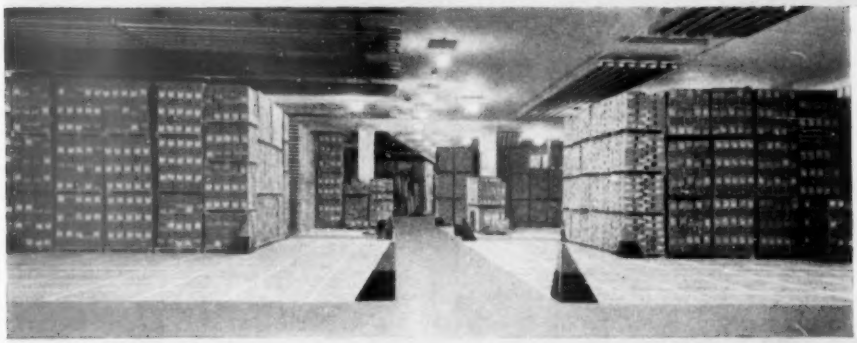
Birds Eye Foods recently completed their Lowestoft Cold Store by adding a 1,000,000 cu. ft. extension, and in order to store their rapidly increasing production of frozen foods it was essential that the extension should be completed and operational as quickly as possible. Smiths solved this problem by building a temporary curtain wall 170′ long down the centre of the store, allowing one half of the store to be used whilst the other half was being completed! This ingenious arrangement enabled considerable economies to be made on storage costs. The whole store, **which is probably the largest in the world, and** holds 9,000 tons of frozen foods, was built by Smiths using their unique unit construction technique. If you are planning any type of project involving cold storage or insulation, start off on the right foot by consulting Smiths, the leading cold store designers and contractors.



The completed store showing the uncluttered interior and pallet layout of the Bird's Eye Store



Another view of the Bird's Eye Store showing part of the temporary wall before removal.



The completed store in operation.

Effective insulation is a question of balance

STYROCELL is a rigid, lightweight material consisting of a profusion of non-communicating air cells encased in polystyrene. By maintaining a fine balance between its weight and the volume of trapped air, STYROCELL provides a barrier of virtually still air—the ideal thermal insulant. In addition to its light weight—1 lb. per cubic foot—STYROCELL is inert, rot-proof and possesses a low water-vapour permeability, good mechanical strength, chemical resistance and electrical properties. Easy to handle and to work, STYROCELL is an inexpensive material that gives new meaning to effective thermal insulation. Available in either standard or self-extinguishing grades—in thicknesses from ½″-10″.

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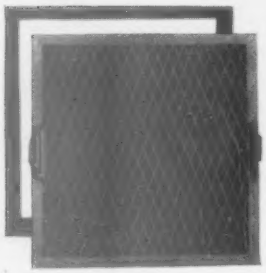
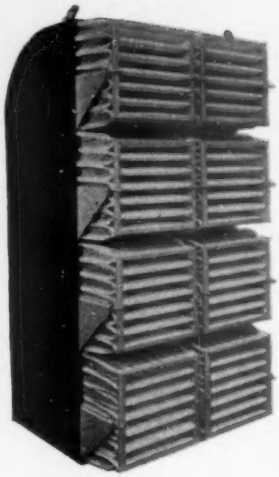
WET or DRY...



VISCO "KM" Type
Oil-Wetted Air Filter



VISCO "MV" Dry Type
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VISCO Air Filters devour dust. Air filtration economics can be solved the VISCO way. Both types are simple, robust, reliable, efficient. The oil-wetted filters operate in such a way that collected dust in turn helps to collect further. Each cell has tremendous capacity and is easily cleaned. VISCO "MV" dry-type filters are over 98% efficient. Each unit will deal with up to 1,000 c.f.m. Throw-away filter elements are easily changed after several hundred hours active life. Full information from THE VISCO ENGINEERING CO. LTD., STAFFORD ROAD, CROYDON. Telephone: CROydon 4181.

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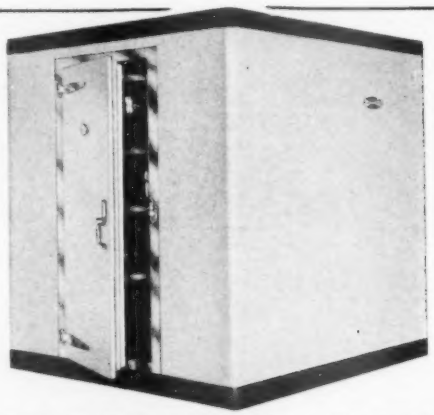
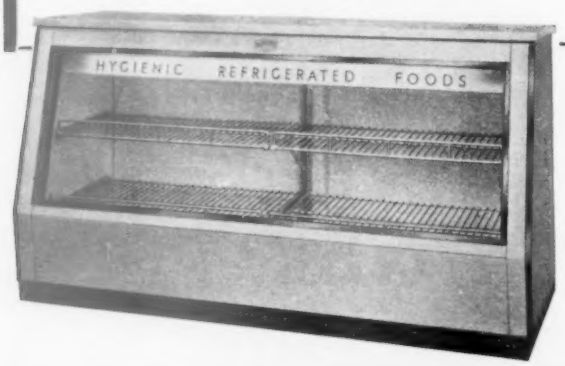
Write now stating your business and requirements. Applications for agencies invited.





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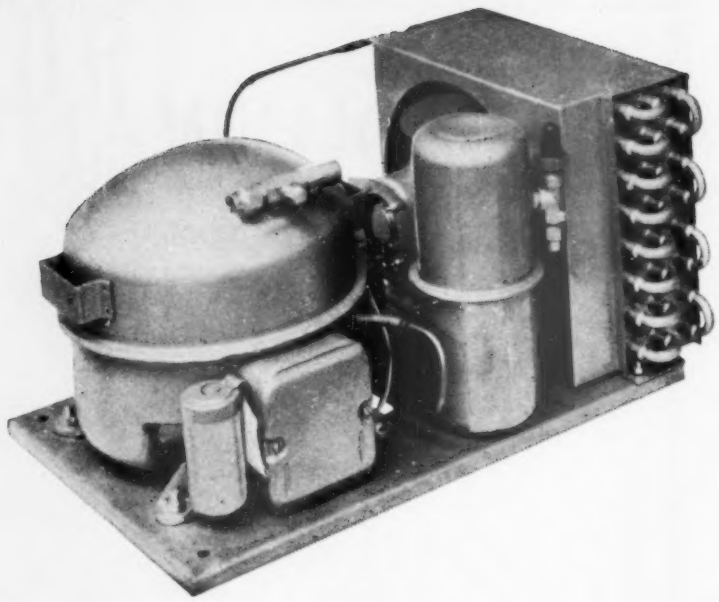

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The Helifrost freezers will be marketed in Great Britain by the Sole Agent in this country, Helimatic Ltd., who will provide nationwide service facilities in close co-operation with the trade.

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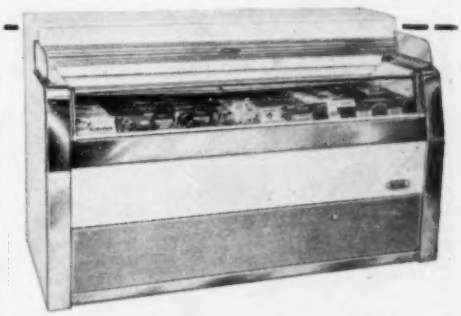

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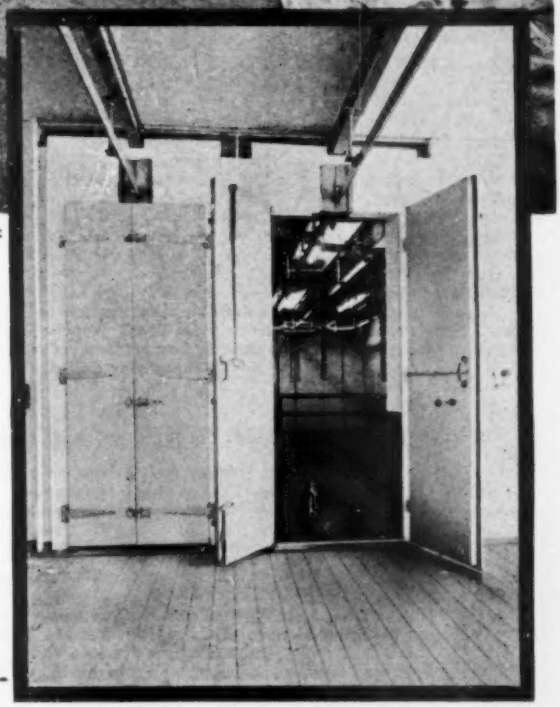

Above: One of the two freezing chambers—capacity 30,000 cu.ft
Right: Interior of one of the chillers.

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and ICE AND COLD STORAGE

Established 1898

VOLUME 63 NUMBER 753

DECEMBER · 1960

Contents

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EDITORIAL . . .

A Grand Ship

A "Freon" by any other name. . .

Another merger

● In a month that was marked by depressing news from the automobile industry, it was a tonic to visit one of Britain's greatest engineering achievements, a 42,000-ton liner. In this field, Britain is still supreme and her prowess in equipping great ships with the finest propulsion and auxiliary plant, including refrigerating machinery, is a legacy that has been handed down for generations. Such a case is the noble vessel *S.S. Oriana*, the largest and fastest ship to come from a British yard (Vickers-Armstrongs, Barrow) since the war. Almost as fast the *Queens* at 31 knots on trial, the Orient Line's latest addition to their fleet carries air-conditioning plant that will eliminate 22 m. B.t.u. per hour—by far the largest in the world.

● Refrigerant nomenclature is still a bugbear of the practice of the cooling art in Europe. A strong plea for standardization of the names of the popular halogens, and others, is being made by the British Refrigeration Association.

● The chemicals usually referred to as halogenated hydro-carbons are already in widespread use as refrigerants in compressor refrigeration systems and their popularity is still growing, state the B.R.A. In contrast to traditional refrigerants such as ammonia, the names of most of these chemicals are unwieldy and their formulae difficult both to memorize and to distinguish from one another. In addition, they are marketed by the producers under brand names For example, the most widely used of the new refrigerants is dichlorodiflouromethane, its chemical formula being, $CC1_2F_2$; another refrigerant, monochlorodifluoromethane, with different characteristics, has the rather similar formula, $CHC1F_2$. The brand names are numerous already and new producers in various parts of the world are still adding to them.

● The council of the British Refrigeration Association considers that all possible steps should be taken to simplify this position, as soon as possible and on a world scale. Not only would simplification secure important economies in labelling, specifications, instructions and similar documentation, but it could obviate any risk of refrigeration systems being re-charged or replenished incorrectly. This latter advantage is particularly important in connexion with refrigeration equipment exported to countries where a difference in languages might cause misunderstanding amongst service engineers. The British Refrigeration Association consequently proposed to the International Standards Organization that it should take the task of simplification in hand and in consequence this formed a working party which met in Paris in October, 1960.

● Delegates from Denmark, France, Germany, Spain, the United Kingdom and the U.S.A. attended the meeting and agreement was reached on a system of complete simplification under which, for example, dichlorodifluoromethane would be known merely as R12 and monochlorodifluormethane as R22, regardless of their brand names or the country of production. The International Standards Organization will now be asked to publish this system to all interested parties for comment with a view to its adoption throughout the world being recommended. In the meantime, manufacturers of refrigeration equipment in the United Kingdom and other countries are likely to anticipate this by adopting the system forthwith.

● A certain amount of rationalization in the refrigeration industry continues. Baker Perkins Ltd. have acquired Alfred Porter & Co. Ltd., and its three affiliated companies, of Stella Works, Teddington, Middlesex. Alfred Porter Ltd. manufacture industrial and commercial refrigerating and dehumidifying plant for use in the air-conditioning, chemical, cold storage, food and dairy industries. William Douglas & Sons (Engineering) Ltd., of Putney, London, another member of the Baker Perkins Group, is also engaged in the refrigeration field and has collaborated for some time with the Porter company.

INTERNATIONAL REFRIGERATION FAIR - 1962

As already announced, the council of The British Refrigeration Association is sponsoring an exhibition in 1962 for manufacturers of refrigerators and all other forms of refrigeration equipment.

Contemporary Exhibitions Ltd., acting with a committee representative of all sections of the refrigeration industry, will organize the exhibition. It will be known as the International Refrigeration Fair and will take place at Olympia, London, W.14, between April 9 and 23, 1962.

Further enquiries will be welcomed and may be addressed to :

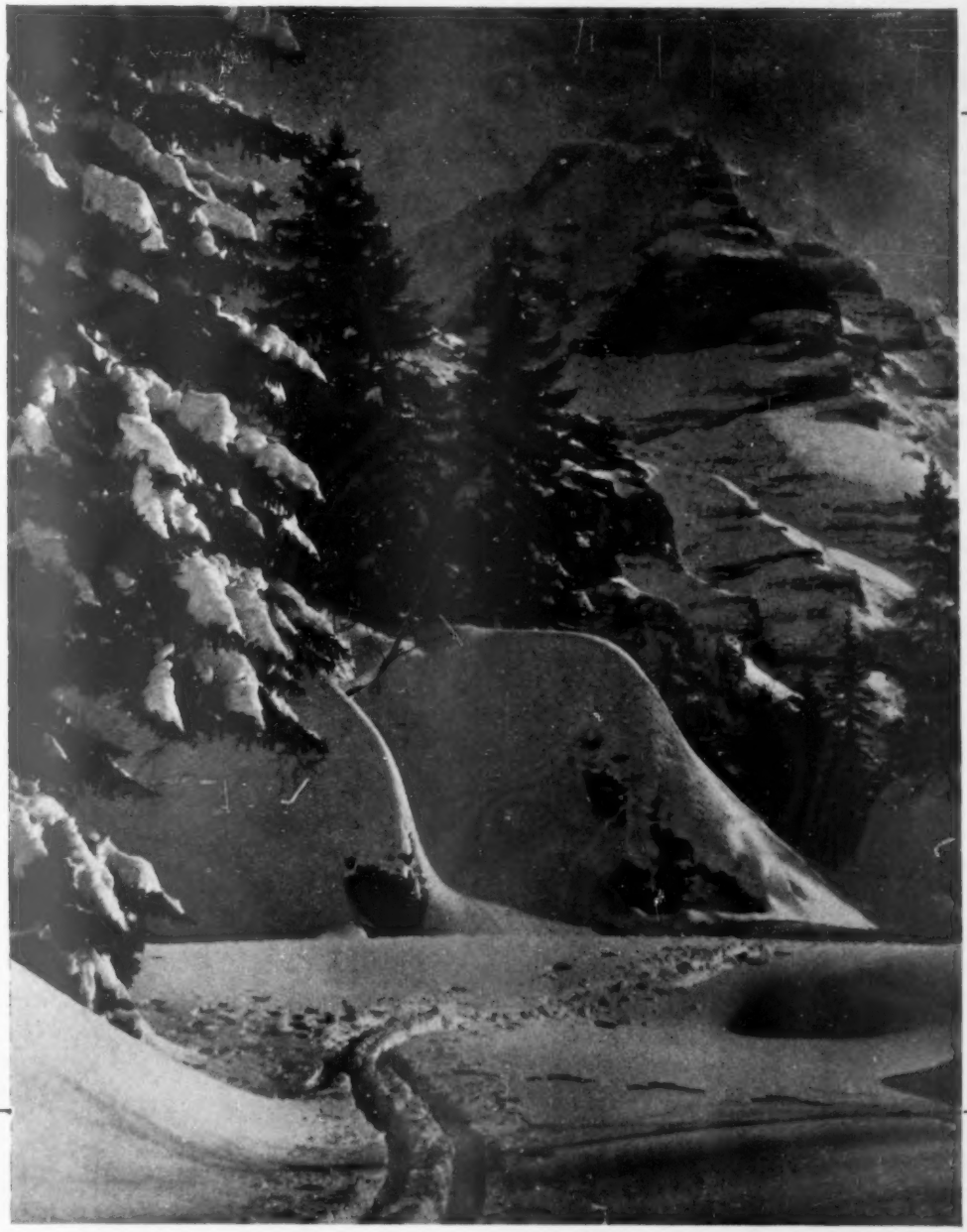
CONTEMPORARY EXHIBITIONS LTD.,
2, Dunraven Street,
Park Lane,
London, W.1.

or : BRITISH REFRIGERATION ASSOCIATION,
1, Lincoln's Inn Fields,
London, W.C.2.

or to : Modern Refrigeration and Air Control, 131, Great Suffolk Street, London, S.E.1.

A Happy Christmas and a Prosperous New Year

to all our readers and advertisers



OUR GREETINGS THIS YEAR to our readers and advertisers, at home and abroad, find expression in this Swiss snow scene taken by a well-known member of the industry, namely, Mr. N. F. T. Saunders, B.Sc., M.Inst.R., managing director of Kelvinator Limited. Mr. Saunders is an associate of the Royal Photographic Society and we think that our readers will agree that this delightful view of the Jungfrau testifies to the eminence that Mr. Saunders has achieved in the photographic world.

NEWS OF THE MONTH

Refrigeration and A-c. Exports.—During October, 1960, air-conditioning and refrigerating machinery (commercial and industrial sizes) to the value of £574,684 weighing 775 tons, was exported from the United Kingdom. Comparable figures for October, 1959, were 1,176 tons, worth £817,722.

* * *

Exports' Analysis.—Of the 775 tons of air-conditioning and refrigerating plant worth £574,684 exported by Great Britain in October—quoted in the preceding paragraph—40 tons went to the Union of South Africa, 13 tons to India, 121 tons to Australia, 12 tons to New Zealand, 41 tons to Canada, 88 tons to "other Commonwealth countries," 40 tons to Eire, 29 tons to Sweden, 128 tons to Western Germany, 61 tons to the Netherlands, 19 tons to Belgium, 13 tons to France, 42 tons to Italy, and 128 tons to "other foreign countries."

* * *

Refrigeration Plant Classified.—Of the total exports of air-conditioning and refrigerating machinery during October, commercial refrigerating machinery accounted for 90 tons, worth £54,365, industrial plant and equipment for 113 tons worth £50,856, and refrigerating machinery, equipment and parts, for 405 tons, worth £313,829.

* * *

Exports of Small Refrigerators.—During October, 825 tons of complete refrigerators and domestic refrigeration equipment were sent overseas from Great Britain. These exports were worth £553,730. The 825 tons comprised 15 tons to the Union of South Africa, 4 tons to Rhodesia and Nyasaland, 4 tons to India, 23 tons to New Zealand, 315 tons to "other Commonwealth countries and Eire," 61 tons to Sweden, 48 tons to Western Germany, 51 tons to the Netherlands, 9 tons to Belgium, 6 tons to Italy, and 289 tons to "other foreign countries."

* * *

Further Fall in "Domestics."—The home demand for British-made domestic refrigerators fell again during October, according to the figures issued by the Domestic Refrigeration Development Committee. Manufacturers' deliveries to the home market, a total of 32,057, were 43 per cent. lower than October last year, when they totalled 56,468. This decline in demand for what has become an increasingly popular product is another example of the damaging effect of the severe hire purchase restrictions and of the present economic policy of the Government. The export position remains satisfactory. October deliveries of domestic refrigerators to the export market, a total of 7,974, show an increase of 23 per cent. on October last year, when exports were 6,464. The total for the first 10 months of the year is 115,078, 40 per cent. higher than in the same period of 1959.

* * *

New Poultry Freezer.—Burnett & Co. of Rothie-Norman, who have been in operation for a considerable period as poultry processors and packers, are planning a transfer to Inverurie where a site is being sought for a new processing plant. Current production by the firm is being very largely taken up by the south of Scotland with additional markets awaiting supplies. If the present plan is approved by the local authorities, the company will erect a new factory to handle a considerable increase in throughput, with freezing facilities for quick-frozen production and cold storage plant to hold supplies against suitable markets. Poultry packing concerns in Scotland have been extending steadily and although there is still some caution with regard to broilers the present indications are that this trade will continue to grow.

★

LEC SALES CONVENTION

The Lec Refrigeration sales convention, held recently at their Bognor Regis headquarters, proved such a success that future conventions are scheduled to take place twice-yearly instead of annually. The convention, which included a study period on the present market situation, and covered Lec's production and expansion plans, was rounded off by a dinner and dance. Mr. Frank Purley, Lec's sales director, is standing fifth from the right.

Mr. John A. Howie has resigned as managing director and from the board of The Lightfoot Refrigeration Co. Ltd. Mr. Godfrey Yem, who has been with The Lightfoot Refrigeration Co. Ltd. for over 30 years, has been appointed general manager of the company.

* * *

Milk Tank Hygiene.—The danger of contamination of bulk tanks used in milk handling was discussed at the Edinburgh and East of Scotland College meeting in November. More efficient education of workers employed in the handling of bulk supplies and improved training in effective cleaning of tanks was required, Mr. A. T. Bryden said. Manufacturers installed bulk tanks but did not give proper training on the method of effective cleaning. The position in England had become very serious. If contamination could not be stopped, similar pressure might happen in Scotland, to insist that all bulk milk be pasteurized. The position in Scotland is not regarded as dangerous, but there is a desire to avoid enforced pasteurisation. In Berwickshire, an attempt is being made by the producers to meet this situation by joining a testing programme operated by the bacteriology department, under which regular sampling is being made, to ensure quality of supplies.

* * *

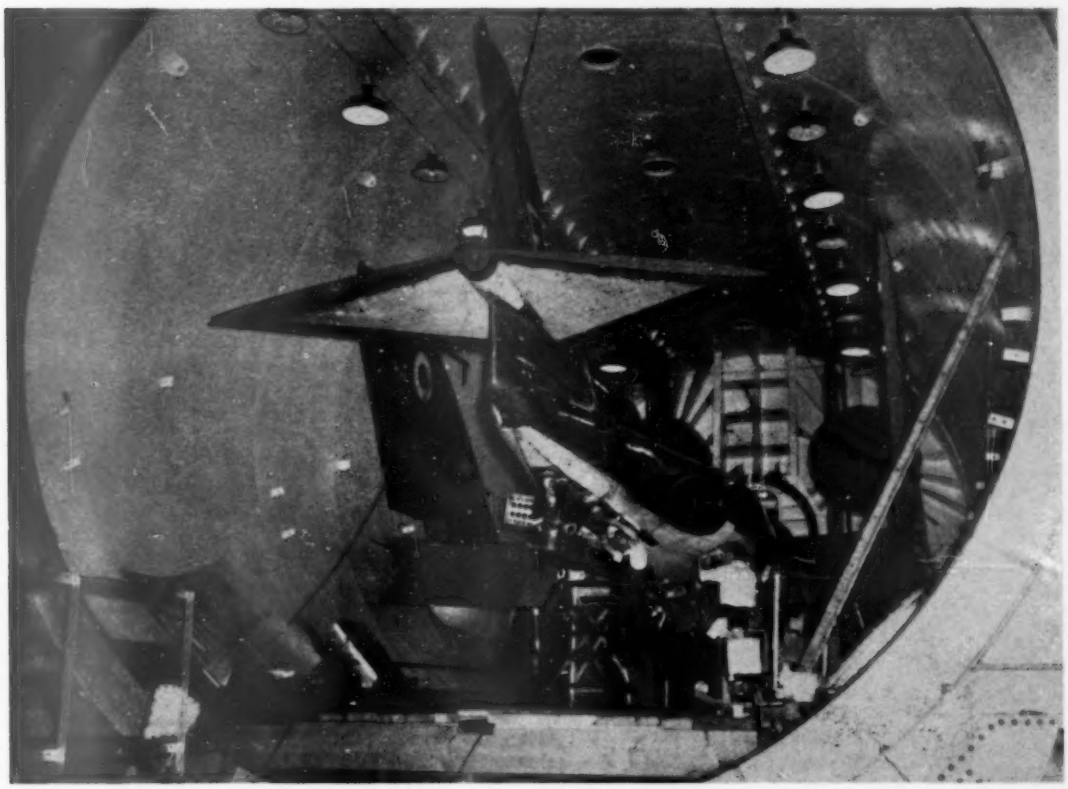
A Commonwealth party given by the 12 members of the Domestic Refrigeration Development Committee was widely attended last month by representatives of the press, radio and television services. The Commonwealth theme was shown to guests by a display of traditional dishes of each Commonwealth country, prepared by the home economists from each DoRDeC company. Guests were welcomed by Miss Nancy Martin, chairman of the Women's Press Club, and by Mr. Morris Craig, vice-chairman of the Domestic Refrigeration Development Committee.

* * *

It is expected that Australia, by mid-December, will have shipped 36,000,000 eggs to relieve the current British shortage. Last week refrigerated ships in British ports discharged nearly 30,000 cases of Australian eggs—more than any recorded in one week in the last three years.

Picture of the Month

Photograph taken recently of a Supermarine Sea Vixen undergoing low temperature tests in the stratosphere chamber at Vickers Armstrongs (Aircraft) Ltd., Weybridge, Surrey. The stratosphere chamber is insulated with Onazote, 12 in. thick over-all, and has been in service since 1951.



The Manufacture of Neoprene

Reducing Heat of Polymerization with Centrifugal Refrigeration Plant

Night scene at Maydown, Northern Ireland.

THE Du Pont Company (United Kingdom) Ltd., established four years ago as a subsidiary company of E. I. Du Pont de Nemours & Co. of U.S.A., have opened at Maydown, Londonderry, Northern Ireland, a plant having an annual production of 50,000,000 lb. of neoprene. The plant was officially opened by Lord Wakehurst.

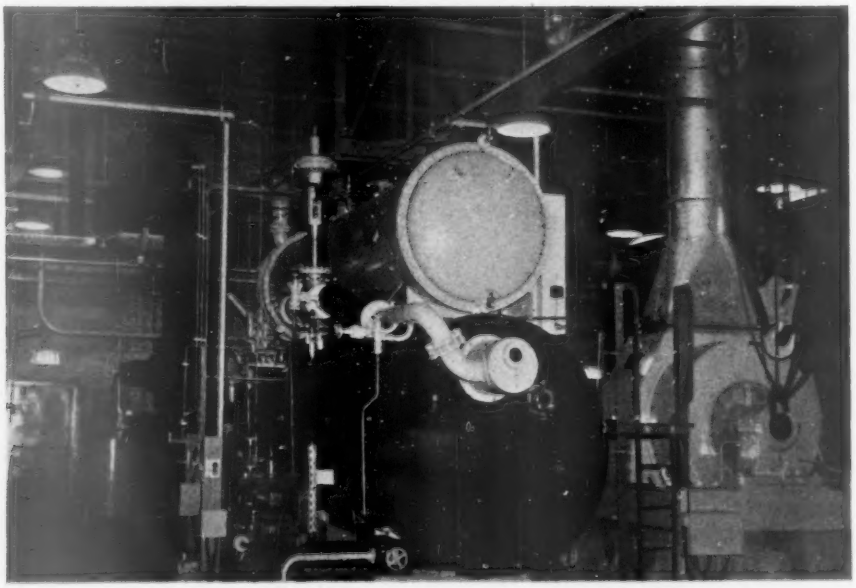
To reduce the heat of polymerization generated during part of the production process, refrigeration is used in the form of cold brine circulation through the jackets of the kettles. Two centrifugal refrigerating plants were installed which are probably the largest single units so far made and installed in the U.K. by an English company.

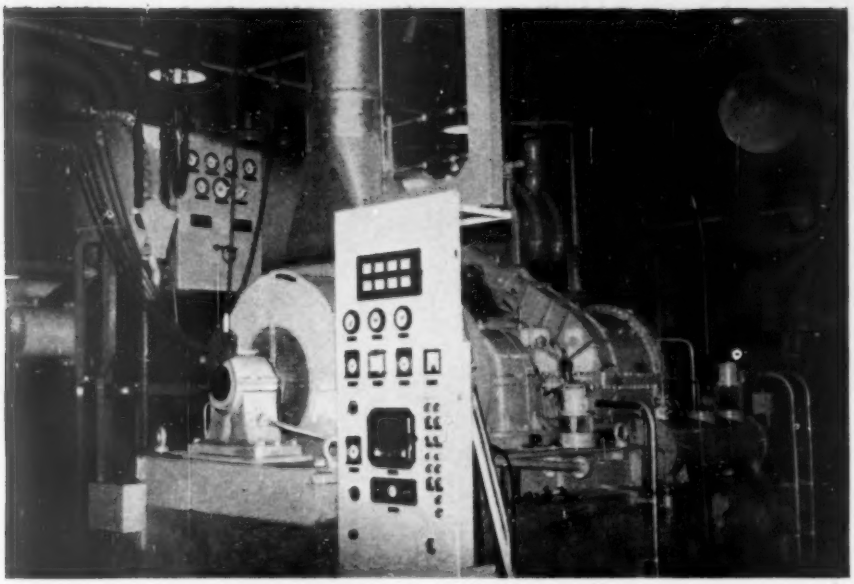
The capacity of the two plants when operating together is 1,630 tons refrigeration (815 tons each) equivalent to an elimination of 19,600,000 B.t.u. per hour when cooling calcium chloride brine to a temperature of about –15° C. and using sea water at up to 20° C. for condenser cooling. Under full operating conditions the power taken by each of the centrifugal compressors is 1,465 b.h.p. The refrigerant used is R12 (dichlorofluoromethane).

The two plants, which are identical, each comprise an electrically driven centrifugal compressor with horizontal shell and tube condenser and evaporator together with various auxiliary equipment.

The compressor has four stages of compression arranged with introduction of flash gas from interstage liquid cooling between the second and third stages. It is of fabricated steel construction. The four stage steel impellers of the radial flow shrouded

No. 1 refrigeration unit at Maydown.





No. 2 refrigeration unit and control panel at Du Pont's.

type operate at a speed of 4,450 r.p.m. and are driven through speed increasing gears by a 1,600 h.p. squirrel cage induction motor running at 1,478 r.p.m. on 3·3 Kv. 50 cycles three-phase supply. The motor is of single bearing construction with the shaft at the driving end supported in a bearing in the gearing casing. The motor is pipe ventilated.

The starting equipment is provided for direct-on-line full voltage starting.

The compressor with gears and electric motor is mounted on a common steel underbed.

The condenser, which is tubed with "Integron" brass tubes, has stainless steel clad tube sheets to give protection against the action of sea water. The evaporator is tubed with solid drawn steel tubes and is insulated with Onazote.

The control of output of each compressor is automatic, being effected by a thermostat with its bulb in the brine outlet from the evaporator which dictates to an automatic controller precisely the amount of decrease or increase in refrigeration capacity required at any moment between 100 and 20 per cent. This automatic equipment which has proved very reliable and accurate is operated pneumatically with air between 3 and 15 lb. per sq. in.

A full complement of safety devices is incorporated for protecting the compressor from abnormal operating conditions and as a precaution against failure of lubrication.

The auxiliary equipment includes a purging plant for removal of air or other non-condensables, a pump down equipment with storage vessel, and a central pressure gauge andthermometer instrument panel.

The plant was supplied by J. & E. Hall Ltd. of Dartford, Kent, the compressor, gears and electric motor being made by Associated Electrical Industries Ltd., Rugby, and the automatic controls by Taylor Controls.

AIR-CONDITIONING AIDS INDUSTRY

Air-conditioning in industry is not only playing an important economic role but is contributing towards a closer understanding between management and employee. A recent application of air-conditioning equipment by Carlyle Air Conditioning and Refrigeration Limited at the Egham factory of Foster Wheeler Limited, designers and constructors of land and marine boilers, oil refineries and nuclear power plants, helps to illustrate the dual effect this relatively new mechanical science is achieving.

In the factory's "clean room" for the assembly of products demanding a fine degree of cleanliness, one of the manufacturing processes requires the temperature to be raised for one of the larger components to 300° F. The heat required to produce this temperature, plus the radiated heat once it has been reached, produces intolerable working conditions. It was necessary, therefore, to install equipment which would lower the room temperature to a level more conducive to efficient operation and at the same time more agreeable to the employees.

The equipment supplied to meet the cooling requirements at Egham comprised two completely self-contained Carlyle model 50K12, packaged air-conditioners, with water-cooled condensers, each unit having a nominal capacity of 10 tons of refrigerating effect. The two conditioners were supplied with plenum sections, arranged to discharge the conditioned air directly into the working area. Following their installation, the room temperature was reduced from over 90° F. to 70—75° F.

S.S. "ORIANA"

THE honour of being the largest and fastest vessel on the Australasian run now belongs to s.s. *Oriana*,* The P. & O. Orient Lines' latest addition to their fleet which went into service on the 3rd instant. Of 804 ft. in length overall, she has a gross tonnage of 42,000 and has accommodation for more than 2,200 persons. She can lay claim also to a "largest in the world" distinction, namely, in the size of the air-conditioning plant which, with a rate of extraction of 22,000,000 B.t.u./hr., cannot be matched by any other marine equipment under any flag.

When it is realized that *Oriana* uses the following vast amounts of food during a 100-day round voyage from London to Australia and home again, one sees how 23 provisions chambers of 72,000 c.ft. capacity are needed to hold the food for over 3,000 persons :—110-tons of meat, 50-tons of poultry, 40-tons of fish, 430,800 eggs, 69,000 bottles of wine, 12,900 of spirits, 110,100 of ales and stouts and 320,200 half-pints of draught beer and lager. This refrigerated provisions space is greater in volume than that devoted to the carriage of perishable cargoes for other shippers at 55,000 c.ft.

The J. & E. Hall refrigerating machinery comprises four 2-stage centrifugal compressors operating on Refrigerant-11 each directly coupled to a single-stage, steam turbine of 547 b.h.p. four 8-cylinder veebloc compressors direct coupled to electric motors of 110 b.h.p. : also various " Hallmark " units.

The centrifugal compressors deal with the air-conditioning duties, each set being capable of abstracting 5,500,000 B.t.u./hr. Speed regulation enables the output to be controlled to give a smaller duty when the vessel is in temperate waters. Below this duty the air-conditioning demand will be handled by the standby compressor forming part of the cargo and provision chamber machinery.

Sir Colin Anderson, a director of the Peninsular and Oriental Steam Navigation Company and of the Orient Steam Navigation Company Limited, who was closely concerned with the design of this ship.

Four 110 h.p., eight-cylinder machines operating on Refrigerant-12 deal with five independently cooled cargo spaces having an approximate capacity of 67,000 c.ft. and twenty-three provision chambers of about 72,000 c.ft. capacity. Nos. 2 and 3 cargo holds are suitably arranged for the carriage of frozen cargoes at +10° F. or for fruit and dairy produce. The

*The name of the new vessel was chosen in the face of a formidable array of conditions which had to be fulfilled to conform to the Orient Line pattern. The greatest difficulty was to find a name beginning with the letters " OR " which had some romantic appeal and on which could be based the design of a badge which would symbolize the link between the first and the second Elizabethan eras. The name *Oriana* was chosen because—according to the Oxford Companion to Literature—it was the name applied by Elizabethan poets to Queen Elizabeth the First. Recently some doubt has been cast on the name *Oriana* having been bestowed on the first Elizabeth, but it is not disputed that *Oriana* did appear in the madrigals written at the time of the first Elizabeth, and although Thomas Morley's collection was not published until after her death, it has been commonly accepted that they were composed in her honour. The badge—a double E monogram symbolizing the two Elizabethan eras, surrounded by the letter O for Orient and capped with a formalised interpretation of an Elizabethan eight-arched pearl crown—was designed by Mr. Milner Gray, R.D.I.

other three cargo spaces are suitable for cargoes at –5° F. while provision is made for the carriage of chilled meat at 28·5° F.

Cooling in all spaces, with the exception of the provision bacon room, is effected by means of cooling batteries with air circulating fans. All spaces are cooled by brine circulation through air cooling batteries but, in the case of the provision bacon room, brine cooling pipes.

Captain Clifford Edgecombe, R.D., R.N.R., in command of the 42,000 ton P. & O.—Orient passenger liner "Oriana."

In addition to these duties the plant provides cold brine for a total of about 40 cold cupboards in galleys, saloons and bars, plus a bulk ice making unit and for drinking water appliances.

Twenty-two independent Hallmark units are fitted for working in conjunction with various bars, galleys, the dairy, soda fountain, ice cream freezer-conservators, automatic cocktail ice-makers, etc.

Thirty-seven Electrolux refrigerator cabinets of domestic type of various sizes are sited throughout the ship.

Polyurethane rigid foam forms the basis of a new method of insulation used in nos. 2 and 3 cargo holds, No. 3 'tween deck, provision rooms, bulk stores, evaporator room, refrigerating machinery space and cold cupboards in s.s. *Oriana*.

The entire insulation, carried out by J. D. Insulating Co. Ltd., to deckheads, decks and bulkheads for all spaces, which have a total capacity of approximately 136,000 c.ft., consists of this polyurethane rigid foam. It was applied by specially designed power-driven machines, giving a complete "envelope" of solid but lightweight insulation without any joints or crevices. The adhesive property of the foam is such that the amount of timber buried in the insulation is considerably reduced. A complete bond is obtained between the foam and the linings, which consisted of white plastic-faced plywood to deckheads and bulkheads of the cargo holds, 'tween decks, refrigerating machinery space and evaporator room. The provision rooms and bulk stores were lined on the deckhead with plastic-faced plywood and on the bulkheads with white pigmented "Filon" corrugated plastic sheets. The foam to the decks was retained with ¼-in.-thick galvanized tread-plates in the cargo holds, and ¼-in.-thick aluminium tread-plates in the 'tween decks and provision rooms.

Mr. E. C. Neville, chief engineer.

Lightweight Doors

In keeping with the general insulation, the doors were specially constructed to a lightweight design that brought about a saving of approximately two-thirds of the weight of the more conventional type of marine cold-store door. They consist of white stove-enamelled alloy panels at the front and back with Holoplast sides that are all machine-screwed together and made completely rigid by filling with polyurethane rigid foam. The doors were placed in Columbian pine main frames and hung on galvanized ball-bearing hinges, and are complete with roller bolt fasteners and backhooks.

The lead and return pipes were also insulated.

Other outstanding features of this luxury vessel are : *Oriana* will be the first big ship to adopt the principle of sideways manoeuvring as a major auxiliary installation. The transverse propulsion units in *Oriana* are not similar to any other types. Each unit comprises an electrically-driven impeller designed and constructed by Vickers-Armstrongs (Engineers) Ltd. on the lines of their well-known axial flow pump installation. The impeller is carried in a horizontal streamlined casing, with geared drive at right angles to the impeller shaft. The impeller casing with its drive is mounted in a cylindrical tube fitted athwartships at some distance below the light waterline. Secondly, over 1,000 tons of aluminium alloy has been used to build one of the largest all-welded all-aluminium structures in existence, the five-passenger deck superstructure of *Oriana*. The major advantages of the use of aluminium alloy in a structure of this kind is that it is ⅓rd lighter than the same superstructure if it had to be made of steel. This has enabled one extra deck more than was thought possible to be built on a ship of this tonnage. Thirdly, passengers in the *Oriana* will be able to enjoy local television programmes at ports of call throughout the world, and closed-circuit telecine and live television programmes while the ship is on the high seas. This will be the first passenger vessel in the world to be equipped with a completely co-ordinated internal and off-air television service.

The sub-contractors were :—

Thermotank Ltd.—Air-conditioning and ventilation.

J. & E. Hall Ltd.—Refrigeration machinery for air-conditioning and food preservation ; lifts.

Shipham & Co. Ltd.—Valves for circulating water to refrigerating machinery condensers.

J. D. Insulating Co. Ltd.—Insulation of refrigerated spaces.

Jablo Plastics Ltd.—Insulation in crew accommodation.

Newalls Insulation Co. Ltd.—Insulation of casings, trunking, etc.

Fibreglass Ltd.—Insulation of lining and ceilings.

Elliott Bros. (London) Ltd.—Electric thermometers for refrigerated spaces.

A NEW RESEARCH ORGANIZATION

The British Industrial Biological Research Association has been formed to study the possible effects upon health and to ensure the harmlessness of substances which may be ingested in food, drink and cosmetics. Supported by a number of leading companies in the food, chemical, essences, plastics, packaging and cosmetics industries, together with certain important distributive concerns, it is welcomed by interested Government Departments and will receive a grant from the Department of Scientific and Industrial Research.

AIR CONDITIONING
the United States Embassy in London

THE United States Embassy building, which was illustrated in our August issue, has now been completed. Designed by the American architect, Eero Saarinen, in association with Yorke, Rosenberg and Mardall, it rises 80 ft. above ground level along one side of London's Grosvenor Square. It has nine storeys and includes a basement, sub-basement and penthouse. The structure is reinforced concrete faced with Portland stone with decorative motives in gold anodized aluminium.

The building has its main entrance in Grosvenor Square, other entrances are in Upper Brook Street and Upper Grosvenor Street. All three entrances have under floor heating, while the whole of the upper ground floor and parts of the lower ground floor, basement and sub-basement, are air-conditioned.

The consulting engineers for all the mechanical services are A. F. Myers & Partners who worked in association with Eero Saarinen & Associates, while the main contractors are Pauling & Co., Ltd. Matthew Hal & Co. Ltd. were responsible for the installation of the air-conditioning services as well as the heating and sanitary services and sprinklers, while the refrigeration equipment was supplied by York Shipley Ltd.

The area air-conditioned is divided into 14 thermostatically controlled zones, each having heater and cooler batteries. Air is pre-conditioned at two main ventilation plants each handling 20,000 c.ft. of fresh air per minute which is electrostatically filtered and channelled to the zone batteries. Air to parts of the building not served by air-conditioning facilities is distributed through concealed ceiling diffusers.

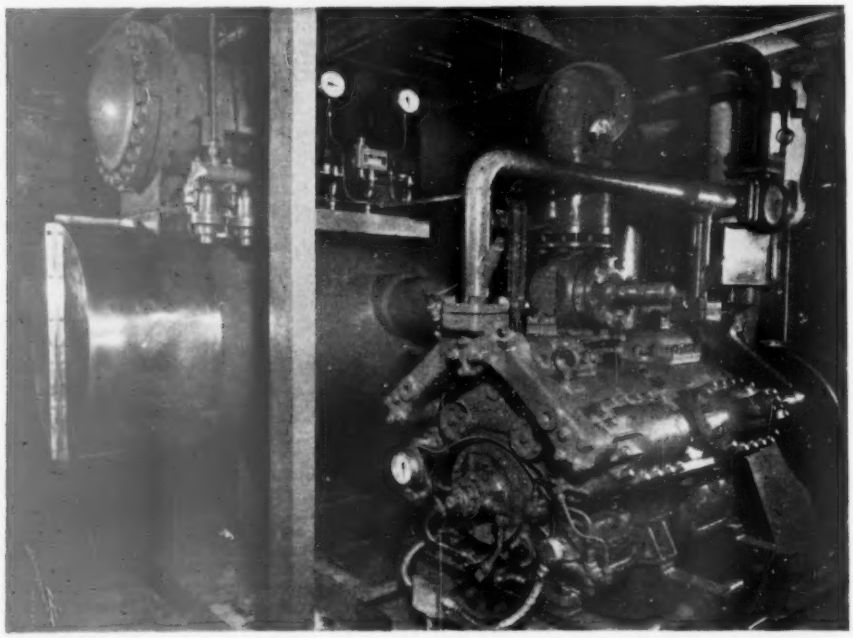
Water piped to the cooler batteries is chilled by a 125 tons capacity York refrigerant-22, package type, water cooling system incorporating a York $3\frac{3}{4}$ in. by 3—in 12-cylinder VW reciprocating compressor. I.C.I. "Integron" finned tubes are fitted to the condensing plant.

Cooling water for the condenser is circulated through a cooling tower located on the roof. The plant is fully automatic and self-adjusting according to load demands. It operates from a main control panel and is wired for remote starting.

Chilled air, charged with a proportion of fresh air from the two ventilation plants is reheated over heater batteries served from low pressure hot-water package boilers.

The conventional low velocity ductwork is, in addition, provided with sound attenuator boxes for noise level control. For supply, re-circulation and extraction, 66 centrifugal fans are employed. All are wired through central switches at the main control panel so that in the event of fire all fan plants can be shut down to prevent risk of fire-spread.

All pipework is arranged so that the water chilling plant can be duplicated at a later date to provide air-conditioning to the whole building.



York Shipley 125 tons package water cooling system at the new United States Embassy building.

Fig. 1.

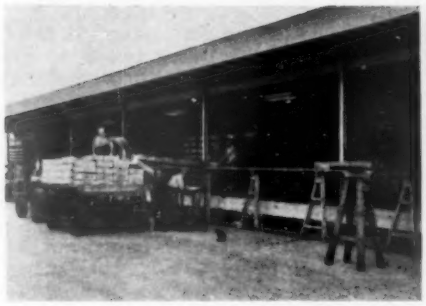


Fig. 2.

QUICK-FREEZING OF CARTONED AND BONE-IN BEEF*

A Recent Development in Australia

By **M. J. McLARAN**

The author, an executive of Hamilton Cold Stores, here gives an account of some of the problems encountered, and the ways in which they were overcome, in the construction of quick-freezing tunnels for cartoned and bone-in beef.

IT is well known that the economic stability of any cold store depends on the utilization of the absolute maximum of space in its rooms. Chilled meat, boned out and packed in cartons, presents a difficult problem for the cold store proprietor. Generally, the majority of meat operators have a standard type of pack for the various cuts, but the size of container is the problem associated with cold storage.

Usually the meat is wrapped in polythene and the carton is waxed both inside and outside. The stores are then presented with a completely air-tight block of meat where penetration to extract the heat is most difficult and naturally the heavier and thicker the package, the longer the process to freeze. It is more or less common knowledge that no matter at what temperature meat is received into store, whether it be 40° or 60°, within two days the temperature will drop to approximately 30° F. and remain static for a further two or three days to break what we call the latent heat barrier.

Once this hurdle has been overcome, the temperature will drop quite rapidly to 20° F. and lower. This operation, apart from wasting space, causes a loss of time and greater handling costs. If these same cartons could be subjected to an extreme cold in the form of quick-freeze tunnels on arrival, then it should follow that the work and consequently labour costs must be reduced, and the cold storage capacity increased. We at the Hamilton Cold Stores have experienced exactly that.

Construction

The site for the quick-freeze tunnels is on vacant land close to the river and adjacent to the main stores. Concrete piles were driven to a solid foundation approximately 19 ft. to 25 ft. deep, and a steel reinforced concrete floor caste over the piles. You are all probably familiar with the construction of concrete cold rooms, so there would be no need to bore you with details. The building took the shape of a rectangle (170 ft. by 46 ft.) divided into 16 sections and a loading platform. Fourteen quick-freeze tunnels, a header room, and a passage running the length of the building connect each of the 15 rooms.

Draw a line lengthways through a rectangle dividing it into one-third and two-thirds, and then crosswise in the larger portion into 15 parts and there you have the floor plan of the building. Each freezing room was insulated with an 8-in. layer of cork on all walls, floors and ceilings, with the exception of the partitions dividing each room. Sheets of rigid foam were fitted in place bonded together with a sealing compound and faced with aluminium sheeting, giving each tunnel a total of 2,156 c.ft., or 30,184 c.ft. over-all (fig. 1).

Before the rooms were partitioned, fin coil flooded units of a capacity of 8 tons with two 23-in. axial flow fans giving 33,000 c.ft. of air per minute, and two 5-h.p. electric motors were bolted to the ceiling of each room with ductwork placed so as to guide the blast in a circular motion through the rooms and back up again through the unit, thus giving complete air circulation. Steel rails 4 in. by ¼ in. were suspended from the ceiling to a height of 7 ft. 2 in. from the floor, three rails to each room running lengthwise with switches to connect each rail placed at both ends, and connected by a hinged length of rail to rails on the loading platform at one end, and in the passage at the other end. This rail system was so planned that every room is connected both to the platform and passage which in turn are connected by a rail running the width of the building. Insulated sliding doors were then fitted to each end of the rooms with two strips of a soft

* This article is based on a paper originally presented at the Commonwealth Cold Storage Association Annual Conference held in Adelaide, South Australia, on June 2, 1960.

rubber bonded to the edge of the doorway completely sealing the rooms.

Operation

We have found through experience that steel frames made in such a way as to form shelves and suspended from the overhead rails by a roller form both a quick method of loading and an excellent means of allowing complete

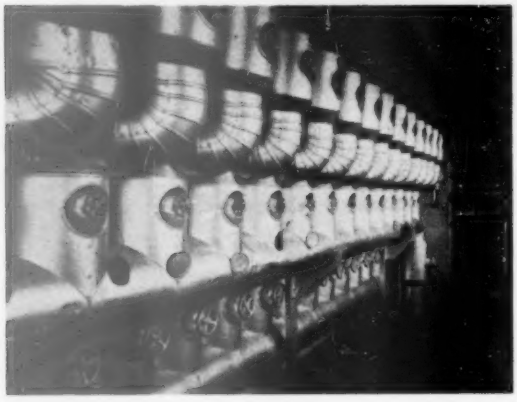


Fig. 3.

circulation to each carton which, when placed in the shelves and pushed along the rail into the freezing tunnel, automatically leave a space of about 4 in. between cartons. Each tray holds eight average cartons or 16 small ones, and each room accommodates 30 trays which makes 240 cartons per room, or 480 of the smaller size. Take an average sized carton as containing 80 lb. and the total capacity of freezing space is in the vicinity of 120 tons, or 600 tons for a five-day week, or a throughput of 30,000 tons per year. Working round the clock seven days a week, we have 42,000 tons per annum, or 63,000 tons if the rooms were to contain all small cartons (fig. 2).

Quarter-beef

The adaptability to convert to quarter-beef is quite simple, merely by using hook rollers instead of the frames. Unfortunately, we have not received any quarter-beef for the quick-freeze tunnel to date, and consequently there are no figures available.

When each room is filled, the doors are shut, the fans switched on, and the valves are adjusted in the header room (fig. 3). On the doors of all rooms, a small black-board has been placed on which is written the name of the client whose meat is in the room, and the time and date the fans were switched on. Care has to be taken that the fan blades are free before switching the motors on. This is done by a quick on-off before closing the door. Pilot lights are provided near the fan switches as a guide that the fans are running. Automatic cut-offs have been placed in the electrical system in case any fan motor is overloaded.

Defrosting is a simple operation performed merely by subjecting the coils to a flow of water through a pipe installed above the unit. A tray underneath catches the run off, which flows outside into a drain in the passage. The time taken to complete the defrosting is approximately 20 minutes.

When the meat is frozen (below 20° F.) for stacking, the trays are pushed out into the passage and the cartons transferred to a conveyor, and so on their way to a designated room ready for shipping (fig. 4).

Refrigeration

A liquid recirculation system was installed separate to our existing recirculation system to supply the quick freezers, which are approximately 200 yards from the engine room. An additional surge drum was employed and the liquid returned by a gear pump, pumping 175 lb. of liquid per minute. Naturally there are two stages of compression. The first is secured by two 75-ton rotary boosters (fig. 5) operating on a suction temperature of –40° with between 17½ in. to 20 in. of vacuum.

The hot gas is discharged up to a maximum of 300° F. into a desuperheater. This drum is a necessary medium between the rotary boosters and the main engine room second-stage compression to break down the heat before discharging into the engine room header at 15 lb. per sq. in. The transference of heat in the desuperheater takes place where the hot gas enters from the top of the drum through a pipe which reaches almost to the bottom. The end was blanked off and perforations near the end allow the gas to escape into a level of liquid and so reduce the temperature of approximately 3° or 4° F. Level masters with automatic alarm bells were fitted to both the surge drum and desuperheater.

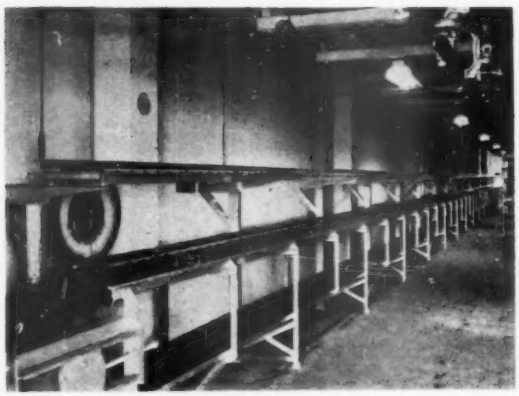


Fig. 4.

An 8-in. suction line insulated to 3½ in. was installed with 1¼-in. liquor line and connected to the header room in the quick-freeze block. Liquor temperature readings at the header room vary from −40° to −50° F. Electrical thermometers were fixed in each tunnel and wired to a recorder near the engine room where readings are logged every two hours.

Results

Various tests have been carried out to determine the time that the meat takes to freeze. The Department of Agriculture and Stock in Queensland performed an initial trial on 14 cartons, average weight 80 lb., with the aid of thermocouples and found a variation in temperatures throughout the particular tunnel as follows :—

	Loading end	*Centre*	*Discharge*
Initial temperature	43°	50°	48°
5 hours	37°	36°	40°
10 „	29°	28°	30°
15 „	28°	24°	27°
20 „	26°	18°	21°
25 „	20°	−1·8°	3·2°

Further tests have since been carried out with thermometers, and the following data were tabled :—

		lb.	*Hours*
Cartons of 4-in. thickness.	Weight	50– 65	12–15
,, 5-in. ,,	,,	65– 70	18–22
,, 6-in. ,,	,,	70–100	22–27

From these examples a tunnel loaded at 10 a.m. can be safely unloaded on the following day between 9 a.m. and 12 noon.

Air temperature readings extracted from the log book for two rooms which we will call " A " and " B," were as follows :—

" *A* "—*Capacity approximately* 8 *tons*		" *B* " *Capacity approximately* 8 *tons*	
Filled 12 noon...	+30° F.	Filled 10 a.m. ...	+21° F.
Fans on 1.20 pm.	−23° F.	Fans on 11.20a.m.	− 8° F.
4 p.m. ...	−28° F.	2 p.m.	−26° F.
6 ,, ...	−28° F.	4 ,, ...	−30° F.
8 ,, ...	−30° F.	6 ,, ...	−32° F.
10 ,, ...	−33° F.	8 ,, ...	−34° F.
Midnight ...	−35° F.	10 ,, ...	−37° F.
2 a.m. ...	−37° F.	Midnight ...	−39° F.
6 ,, ...	−39° F.	2 ,, ...	−41° F.
8 a.m. ...	−39° F.	4 ,, ...	−42° F.
10 ,, ...	−39° F.	6 ,, ...	−43° F.
Noon—fan off...	−36° F.	8 ,, ...	−44° F.
2 p.m. ...	−36° F.	10 ,, ...	−45° F.
26 hours—Emptied.		26 hours—Emptied.	

" A " 1 sample carton, 80 lb., 15° F.
" B " 1¼ ,, ,, , 80 ,, 13° F.

Labour, the all important cost of any business, was carefully watched, and after a modification or two a fixed number of employees were allocated to perform the necessary duties.

An interesting fact has arisen from the power consumption of the rotary boosters together with the fan motors. Over a period of four weeks, the throughput was 2,178,294 lb., or approximately 972½ tons. The power consumption was 141,282 kW., which works out to 0·065 kW. per lb., or 0·065 of a 1¼d. per lb.

The justification of the expense of installing the quick-freeze tunnels is supported by the saving in labour, time and space. Holding rooms have much more capacity than formerly, and there is a guarantee that the meat is hard frozen and in good keeping condition.

Summary

In summarizing, there are quite a few points to bear in mind for the successful operation of quick-freeze rooms.

It is of prime importance to choose a site within easy reach of stacking rooms, and so keep labour and/or mechanical costs to a minimum. The chambers should be reasonably small to obviate excessively heavy equipment and to allow a quick throughput. They should be constructed so as to be readily adaptable to receive any type of product whether it be cartoned meat, quarter-beef or any form of package.

Planning the traffic flow in and out of the rooms should be such that there is no confusion or disruption to slow down the operation of receiving and discharging, as it would be imperative for any plant working to its fullest capacity to turn the load round with as little delay as possible.

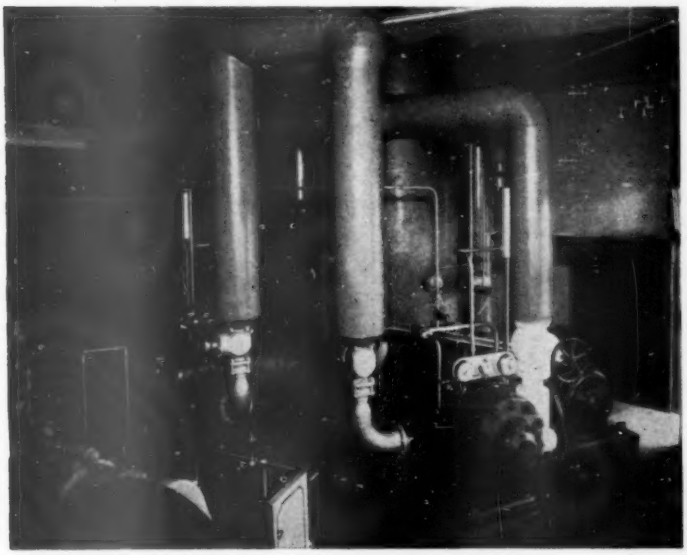


Fig. 5.

Household refrigerator production in West Germany this year is likely to total over 2,200,000, as against 1,900,000 last year. During the recent Household Goods Fair in Cologne it was stated that every third household in West Germany is now equipped with a refrigerator.

* * *

Insulation of 10 large storage tanks at the new Esso Refinery at Milford Haven, which are 40 ft. to 150 ft. in diameter and from 42 ft. to 48 ft. high, consists of Eldorite mineral wool slabs, a product of the Cork Insulation & Asbestos Co. Ltd. With an exterior finish of corrugated aluminium sheeting and banding and with galvanized sheet metal for the roofs, a special metal framing was designed to secure the insulation and exterior finish to the tanks. The manufacturers also undertook the insulation of many unit vessels and of the ducting and pipe-work in the boiler house. Eldorite was also supplied to Foster Wheeler Ltd. who were responsible for the insulation of the pipe-work connecting the various units and the oil storage tanks.

Air view of s.s. "Hawaiian Citizen" in the Pacific on her maiden voyage to Honolulu, when she carried 211 dry cargo containers and 26 refrigerated units.

Refrigerated Container Terminal

LOS ANGELES INSTALLATION NOW FULLY OPERATIVE

PUSH-BUTTON loading and unloading of both dry cargo and refrigerated items are now in full swing at the Port of Los Angeles' first container terminal which is preferentially assigned to the Matson Navigation Company for its triangular service between that port, Honolulu and Alameda in San Francisco Bay.

A vessel lately serviced was the *Hawaiian Citizen*, recently converted full-container ship ; she carries up to 72 refrigerated containers on a regular basis, thus providing a store-door service for perishable goods.

The availability of refrigeration throughout the cargo-handling process suggests a much broader container service by Matson, which has long linked Australia and New Zealand with Los Angeles and the entire California area. Both countries are sizeable markets for West Coast importers of frozen meat, fish and dairy products.

Matson says it has no immediate plans to extend its container programme to Australia and New Zealand but concedes that both countries will eventually be included in the company's programme.

Refrigeration during transit time between storage plant and container dock is accomplished by means of portable propane motor generator sets. Dockside refrigeration is ensured through the container's electrically-driven compressor and air-cooled condenser. The containers are simply connected to 220 volt outlets on the wharf. And when the refrigerated containers are lowered into the holds of the ship, they are plugged into the ship's electrical outlets and water-cooled condensers take over.

The benefits of this method of handling and transporting both dry and refrigerated cargo—a virtual door-to-door movement of goods from shipper to consignee with Matson's dockside cranes at each port of call taking over the intermediate lift-on lift-off operations—needs little elaboration. But it is worth noting that the shipping firm claims its system " can cut as much as three days off the intransit time of cargo from shipper to consignee."

The *Hawaiian Citizen* calls every 16 days at her special container terminal in the Port of Los Angeles. In addition, Matson's deck-carrying container ships, which have used berth 136 and two large Navy cranes since 1958, continue to load and unload containerized cargo.

Matson's container fleet was further augmented recently by two C-4 type vessels—the s.s. *Californian* and s.s. *Hawaiian*. Both have been converted for use as bulk sugar and container carriers in the Hawaiian trade. Each has a capacity for 180 containers on deck and 10 more in its holds where about 15,000 tons of sugar are also carried.

In all, Matson's container fleet now has a collective container-carrying capacity of more than 1,100 units at one time.

N.B.T.S. FLEET USES SPARSHATT BODYWORK

THREE Austin ½-ton vans, completely fitted out for the distribution of blood plasma, and cooled in each case by three eutectic inserts held in a special rack at the top of the insulated interior, have been built by J. H. Sparshatt & Sons Ltd., Portsmouth, for the National Blood Transfusion Service.

These vans use the company's new patented frameless stressed skin construction. It is well

known that a considerable quantity of heat is absorbed into the body through the double framework and ties between the frames, and Sparshatt's have perfected a system wherein these frames are partially or completely dispensed with and the necessary strength is derived from a unique folded panel construction.

Heat leakage is reduced in many other ways including a special "egg box" construction to the intermediate bearers so that the cross-sectional area of the bearers is reduced to a minimum. A "container-in-body" technique has been evolved.

The refrigerated container is installed within an outer body shell and air enters through special vents and is allowed to flow between the two skins, thus dissipating solar heat to a very great extent and relieving the inner container of high temperature. To prevent leakage of moisture into the Insulation, alloy floors are argon arc welded into a single waterproof tray.

Mechanically-Operated, Sliding, Insulated Door with Positive Seal*

By FRANCIS HARBORD, Chief Engineer, Autozero Limited, Dublin

A POST-WAR development in handling by fork truck and pallet has led to a need for larger doors to refrigeration chambers compared to those of pre-war times. In planning a new one-floor cold store in Dublin, Ireland, my company were faced with the problem of designing a hinged door 9 ft. 6 in. by 6 ft. wide. It was decided in 1955 to experiment with a radically altered door. This took the form of a travelling, horizontal, slid ng design.

The sliding door has become almost a necessity due to the modern trend to palletize, which means considerably larger doors to admit the load and fork truck—and more so, if ton loads are stacked to 16 ft. or 20 ft. high. Under such cond.tions openings of approximately 9ft. 6 in. high by 6 ft. wide have proved satisfactory. It may interest you to note that a door of only 5ft. width does not give sufficient working clearance for pallets of from 40 in. to 42 in. wide ; invariably the truck operators damage the door frame, whereas we have now been operating for the past four years without any damage.

A door with 6 in. of insulation with the above dimensions and hung by the orthodox hinged method is not only heavy and unwieldly partly due to the necessary bracing which is essential in this design, but sooner or later will begin to sag. Sometimes it is customary to fit a jockey wheel on one corner of such doors to support the overhanging weight but even if this method is adopted a loss of time will result in the opening and closing of the door together with loss of ground space, in practice amounting to over 40 sq. ft. of floor area to allow the operator to open or close the door; also if two trucks are operating one in the cold store and one outside, pallets can be placed hard up to the door opening thus reducing the handling time.

The sliding door eliminates not only a loss of floor space but saves the continuous maintenance of such a heavy swinging door, and lends itself admirably to fully automatic control, thus saving in manpower and time. Remote control can be situated at any convenient position to synchronize with the speed of the truck load to the speed of the door travel, allowing the operator immediate entry to the store or cold chamber without stopping the vehicle. Closing the door can be effected by similiar remote control in the store.

Where the hinged type carried all its weight on one perpendicular member the sliding door is hung by a horizontal top member, thus eliminating any possibility of sag.

After many experiments a door has been designed with the minimum amount of equipment, and speed of opening is in the region of 36 ft. per minute, that is to say, with a door 6 ft. wide the operation takes approximately 10 seconds. The electric drive is a three phase reversible type motor with the necessary reduction gear and a chain drive is used in conjunction

Continued on page 1260

*This article is based on a paper originally delivered before Commission No. 5, of the International Institute of Refrigeration, at its Congress in Marseilles in September.

THE ENTROPY CLUB

THE tenth annual general meeting of the Entropy Club was held on Saturday, October 22, 1960, at Beales Restaurant, Holloway Road, London, N.7.

Mr. F. Hagger was re-elected president, Mr. J. K. Hadley hon. secretary and treasurer, Mr. G. E. Virgo, news editor. Messrs. C. Dellino and E. Baker were elected hon. auditors, Messrs L. Arnold and M. Tiley retired under the rules from the executive committee, Messrs. W. Boast, R. Evans, F. Wallis, P. E. Bastick, B. Singh and W. J. Vandone being elected to the committee and at a later committee meeting Mr. Vandone was re-elected chairman.

The annual dinner was held at the same place after the A.G.M. Mr. Vandone took the chair and 45 members and guests were present. The official guests were Mr. J. A. Howie, managing director of The Lightfoot Refrigeration Co. Ltd., Dr. D. R. Scott, M.Sc., head of the National College and current students from the National College.

Mr. Howie proposed the toast of the club and said he was intrigued with its name ; he had tried to obtain a definition of its title and had been given various explanations but had been baffled with formulae. He was pleased to see overseas visitors present and then mentioned production committees and the rights of the common man. He felt the uncommon man should be considered, the club surely qualifying for the distinction of being uncommon ; it was exclusive as it was confined to ex-students of the National College.

Mr. Howie stressed the present generation of engineers should not mistake their importance ; he felt his generation had erred in this respect. Businesses were formed to make profits but there was a sickness in the industry due to its management by people who were not engineers. We should never be classed as technicians—engineers and scientists should be at the top and they should go out and attain that position. We should broaden our outlook by going abroad, learning new techniques. The value of our training and the help of our wives were essential ; we should like an active life and obtain satisfaction from what we did. The refrigeration industry was very fascinating and he attributed the lengthy life span of its pioneers to their interest in its work. He liked the initiative and concept of the club which was truly international.

Mr. F. Wallis replied to the toast and thanked Mr. Howie for his advice and said it was a pleasure to be called " uncommon."

Mr. G. Strauss in proposing the toast of " The Guests," said, how happy they were to have Mr. Howie, Dr. Scott and current students with them. He welcomed them—Mr. Howie as a leader of industry was noted for his interest in the National College ; he had helped students after their technical education by giving them industrial experience.

Dr. Scott as head of the National College dealt with its administration and they were impressed with his work in the planning of the new building. He paid a tribute to Dr. Scott's work with personal problems of students especially those from overseas. The students were very fortunate in having the help of their two guests. They hoped the current students would be interested in their activities and would join the club on completion of their course.

Dr. Scott in reply said both Mr. Howie and himself had enjoyed the function. As head of the college he was rather a new boy having been in that position for only two years. He gave details of the progress of the new college and hoped ex-students would still regard themselves as members and invited them to re-visit it.

Mr. F. Hagger, the president, said in 10 years the club had gone from strength to strength and he paid tribute to its officers. He said he had been elected the previous year in his absence to succeed Mr. G. L. H. Bird as president, who was a master of his profession. He had been in that office for nine years, and probably was taken for granted but his guidance had been of immense value as well as his eagerness and fatherly advice to students often far from home. Mr. Hagger, on behalf of the club, offered sincere thanks and presented Mr. Bird with the first new club tie amid the singing of " He's a jolly good fellow."

Mr. Bird thanked Mr. Hagger for his kind remarks and the function continued to midnight with students meeting old friends.

The annual dinner of The Entropy Club. Chief guests were Mr. J. A. Howie, fourth from left, standing, and Dr. D. R. Scott, head of the National College.

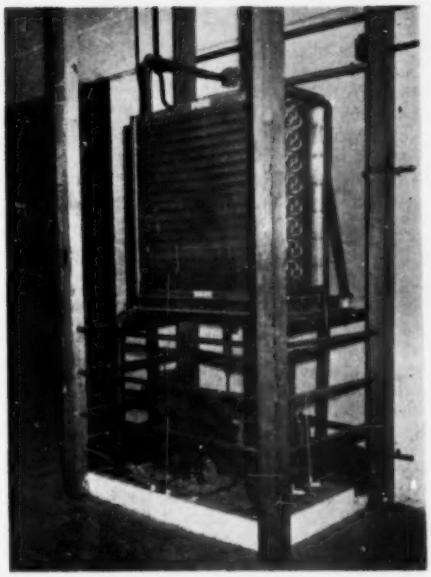
NEW INSULATION-FIXING METHOD used for Surrey Cheese and Butter Store

A COMPLETELY new system of insulation fixing was employed by L. E. Clifford Ltd., of Epsom in executing a 22,000 c.ft. distribution depot at Merton, Surrey, for Peter Keevil & Sons Ltd.

The method of construction was as follows : first, walls were vapour sealed, then without any groundings whatsoever, 2 in. of expanded polystyrene, ¼ in. tempered masonite, were fixed in 8 ft. by 4 ft. sheets by using a Rapid explosive hammer firing special nails through 1 in. timber, ¼ in. Masonite and 2 in. polystyrene into the brick wall or concrete. While doing this, a test was made to remove a panel of insulation after it was fixed. The only way that it could be removed was by using a hacksaw and cutting through the nails. This is proof enough of the solidarity of a nail fixed into a brick wall.

The two Searle Manufacturing Co. ceiling-suspended coolers used were specially selected to maintain correct humidity and the three-cylinder compressor type PH was supplied by L. Sterne & Co. Ltd.

The condensing unit was specially built by Clifford's of Epsom, on site, and set in a 9 in. concrete bed. This, of course, eliminated all vibration and noise to an extent that one is able to stand a penny on edge on top of the compressor whilst still running.



We learn from Mr. A. G. Stanley, who was responsible for the installation, that the cost was not lower in any way than the conventional method but Clifford's were able to complete the job in record time, thereby, in effect, saving the customer money.

Left: One corner of the new store. In this picture can be seen, dark suit, Mr. D. R. Tisman, director, L. E. Clifford Ltd., and Mr. A. G. Stanley, of the same firm. The Searle cooler can be spotted in this view. Above is the condensing set built up on site by Clifford's, incorporating a Sterne compressor.

REFRIGERATION PLANT DONATED TO DORSET COLLEGE

Experiments to be Carried out on Egg Cooling

A GIFT of a Prestcold egg-cooling installation has been made to the Dorset Farm Institute by a group of Prestcold distributors in south and south-west England. They are W. J. Allsop & Sons Ltd., of Torquay ; Gardiner Refrigeration (Bristol) Ltd., Hampshire Refrigeration Ltd., Southampton ; and Frigid Supply Ltd., Bournemouth, who also installed the plant.

Prestcold's, well-known " Producer " model, which keeps eggs in fresh-from-the-nest condition for maximum grading, was built in conjunction with the Egg Marketing Board. The E.M.B. laboratories in London are also Prestcold-equipped.

The principal of the Dorset Farm Institute said that the estate sub-committee were very pleased indeed to accept the refrigeration equipment. The plant will be used by the poultry husbandry section to determine the benefits offered to egg producers by cooling new-laid eggs and storing them at ideal temperatures, prior to despatching them to the packing station or hatcheries.

In some States of America, cooling eggs by refrigeration is enforced at poultry farms, egg packing stations and retail stores.

The lecturer in poultry husbandry at the Dorset Institute said that during the next 12 months he will place half his egg yield into the cooler, and store the rest under conventional conditions. By keeping accurate records of the weight of each batch of eggs when they are graded at the packing-station, and their quality reports returned by hatcheries, the lecturer and his students will be able to assess accurately the merits of the Prestcold cooler.

A small stone-built out-house, situated next to the poultry houses, has been converted to make the cooling-store. The roof of the building is insulated and a Prestcold unit cooler 560 coupled to a ½ h.p. AS50H, maintain a temperature of 50 to 55 degrees, throughout the 200 c.ft. store. Temperature and humidity recording apparatus has been supplied with the refrigeration plant.

In addition to many farmers, the poultry advisory officer for Dorset is showing a keen interest in the tests.

It has been established that eggs which are not cooled soon after laying lose weight through evaporation. They may also develop exterior mould, have enlarged air-cells or become useless for hatching.

As eggs are graded by weight this factor alone can result in a loss to the farmer of between 15s. to 20s. on each dozen eggs.

The long-term aim of using refrigeration in the poultry industry, explained the lecturer, will be to provide for the consumer an egg which by merit of refrigeration used by the producer, the packing station and the retailer, will be as fresh as when it was taken from the nest. Also by providing top quality eggs throughout the year for the hatcheries, and working in conjunction with battery hens, it will be possible to maintain a regular supply and stable prices of eggs and birds.

The Dorset Farm Institute is established under the Dorset County Council's education committee, at Kingston Maurward, Dorchester. Covering some 444 acres, it is run as a full scale farm embracing most branches of agriculture with an accent on the Dorset county farming precedents. It is an agricultural training college where students take academical and practical instruction to obtain degrees in agriculture.

Seat of the college is Kingston Maurward house, a fine edifice built in 1719-21 by a cousin of Pitt. George III was a frequent guest, and Thomas Hardy was educated in the house. He wrote his first book about the Mistress of Kingston Maurward and the barn and greenwood tree of his novels are there.

NEW LOW PRICE FOR "ASTRAL" BUILT-IN REFRIGERATOR

THE built-in 1·6 c.ft. refrigerator which Morphy-Richards " Astral " recently introduced on the British market is now down £3 in price to £32 10s. Earlier in the year, this built-in model was launched in the U.S.A., where it has proved extremely popular.

This new " Astral " model is meeting the ever-increasing demand in Britain for a built-in refrigerator for installation in fitted kitchens. Three versions of this model are available—for operation on either electricity, town gas, or bottled gas. The bottled-gas version has been designed for caravans, trailers, boats, country cottages, and seaside chalets.

Within its 1·6 c.ft. storage capacity there is a three-level shelving area of over 3 sq. ft. There are two wire shelves and the top one is recessed to accommodate tall bottles. An egg rack and a bottle rack are in the door interior. The cooling unit has two ice-trays making 24 cubes (over 1 lb. of ice) and can alternatively store up to 4 lb. of frozen food. A polystyrene drip-tray is also provided.

This easily-installed built-in refrigerator has been designed with the space problems of the tiniest kitchenette in mind. For this reason, it is available with the door opening either from the left or from the right. Its compact external dimensions, including the ventilator louvres which are provided, are : height 31 in., width 21 in., and depth 22 in. Its silent absorption cooling unit is thermostatically-controlled and cannot cause radio or TV. interference. The cooling unit is guaranteed for 5 years and all the other parts for 12 months. The cabinet exterior and louvres are in either white or cream stove-enamel and the polystyrene interior is pale blue.

MINIVEIL DESIGN

MINIKAY Limited are continually searching for the ideal design of Miniveil air curtain for use on open cold room doorways. While it is necessary to maintain the high degree of efficiency associated with the original design of Miniveil air curtain units, it was felt that a further improvement could be achieved if a unit could be produced that, for all practicable purposes, was universal in application and free of maintenance problems. The cylindrical type of Miniveil has the advantage that it is now more compact than any of its predecessors, its

sectional area is such that it can be fitted into sites where there is only a space of about 16″ × 16″ available over the cold room door. The main body is fabricated from resin bonded glass fibre which is corrosion free.

The Institute of Refrigeration Bulletin

Institute Headquarters: New Bridge Street House, New Bridge St., London, E.C.4 (CENtral 4694)

JANUARY MEETING

At the meeting of the Institute to be held at 5.30 p.m. on Wednesday, January 5, 1961, in the Memorial Building of the Institute of Marine Engineers, 76 Mark Lane, London, E.C.3, R. Gane, M.A., M.SC., PH.D., A.R.I.C. and D. H. Shrimpton, M.A., PH.D., will present a paper entitled "The use of two-stage freezing procedures for eviscerated chicken."

The following is a summary of the paper :—

> It is the present fashion to require a white appearance to frozen chicken which necessitates a high initial rate of freezing either by immersion in a cold medium or by using air at –30 to –40° F. in a blast freezer. Having achieved the requisite extent of superficial freezing the remainder of the freezing process can be achieved under less stringent conditions *e.g.* in a cold store at 0° F.
>
> Calorimetric measurements have been made to determine the quantity of heat extracted by immersion in brine of wrapped chickens at 14° F., 5° F. and –4° F. for different periods. Similar measurements have been made on chickens partially frozen in an air blast at –40° F.

ANNUAL DINNER

The sixty-first anniversary dinner of the Institute will be held at Grosvenor House, Park Lane, London, W.1, on Wednesday, January 25, 1961, at 7 for 7.30 p.m.

Full details and forms of application on which to apply for tickets have already been forwarded to all members.

INTERNATIONAL HEATING AND AIR-CONDITIONING EXHIBITION

An International Heating and Air-Conditioning Exhibition is to be held in Chicago, U.S.A., from February 13 to 16, 1961. Ashton & Mitchell Travel Ltd. propose to make arrangements for any members of the Institute who might wish to visit the exhibition.

The inclusive cost, covering air transport and hotel accommodation for a eight days, one or two of which might be spent in New York en route, would probably be under £200 per person.

Full details may be obtained from Mr. D. J. Lloyd Davies, Ashton & Mitchell Travel Ltd., 2, Old Bond Street, London, S.W.1.

MEMBERSHIP

At the meeting of members held on September 21, 1960, the following were elected to membership of the Institute :—

Members

*Fischer, Harold Walter, 83, Wise Lane, Mill Hill, London, N.W.7.

*Harrison, Ernest William, "Timberscombe," Grenofen, Tavistock, Devon.

Lukacs, Karl Ludwig Adolf, 7, Telford Parade Mansions, Streatham Hill, London, S.W.2.

* Transfer from Associate Member.

Associate Members

*Brown, Robert Frederick, 22, Mayfield Road, Streetly, Sutton Coldfield.

Burton, Philip, Glenbrook, Paradise Road, Teignmouth, S. Devon.

Henson, Thomas David, c/o Qatar Petroleum Co. Ltd., P.O. Umm Said, Qatar, Arabian Gulf.

*Jordan, Clive Maxwell, c/o Ahmadi Air Conditioning & Refrigeration Co., P.O. Box 7072, Kuwait, Persian Gulf.

Manning, Peter Alan, 273, Nantwich Road, Crewe, Cheshire.

Ross, Donald Sutherland, 3, Keir Drive, Bishopbriggs, Lanarkshire.

* Transfer from Graduate.

Associates

Ashoo, Khaldoon Andrus, Basrah Petroleum Co. Ltd., P.O. Box 21, Basrah, Iraq.

Austin, Victor Albert, 55, Kingston Road, High Wycombe, Bucks.

Boyes, Brinley Lionel Nairn, 77, Charminster Drive, Cheylesmore, Coventry, Warwickshire.

Bradley, Peter, 77, Devonshire Road, Sheffield.

Bridge, Kenneth William, 24a, Cookson Street, Blackpool, Lancs.

Chicken, John Fitch, 70, Strathearn Road, Edinburgh, 9.

Edginton, Hugh John, The Well Cottage, Five Mile Drive, Oxford.

Martinelli, Bernard, 178, Wellington Street, Grimsby, Lincs.

Seaman, Stephen Mark, 19, Glendon Street, Leicester.

Thompson, Henry Alvert, 28, South Way, N. Bersted, Bognor Regis, Sussex.

Turner, William Gordon, 89, Red Lees Road, Cliviger, Burnley, Lancs.

Graduates

Ahuja, Yashpal, Research & Development Section, J. & E. Hall Ltd., Dartford, Kent.

Brown, Reginald William Viney, 55, Grange Park Avenue, Winchmore Hill, London, N.21.

Gee, Roy David, 268, Highters Heath Lane, Kings Heath, Birmingham, 14.

Goodwin, Timothy Peter, Westlea, Runnymede Road, Ponteland, Northumberland.

Hunns, Anthony Donald, 266, Wightman Road, Hornsey, London, N.8.

Khosla, Om Parkash, 65, Inverness Terrace, Bayswater, London, W.2.

Leung, Yui-Cheong, 124, Fa Yuen Street (2nd Floor), Mongkok, Kowloon, Hong Kong.

Seshadri, Raghavachari, Rajaji Road, Nehrunagar, Chromepet P.O., Madras, India.

Watson, Roy, 37, Ravenscroft Avenue, Wembley, Middlesex.

Students

Mackenzie, Hamish Ian, 8, St. Thomas Road, Edinburgh, 9.

Pounder, Robert William, 50, Meadway, Upton, Wirral, Cheshire.

DEEP FREEZE and the Processing of Baked Goods

By J. T. Herbert, M.Inst.R.

Continued from November

Referring to the question of separating the freezer from the store to minimise temperature fluctuations in the latter I have two pictures showing how this has been accomplished with the minimum expense by the use of a sliding partition. Here we are standing in the freezer looking towards the store and the three sliding partitions are all on the left-hand side. When freezing is being undertaken this compartment can be completely closed off from the store by moving two of the three sliding doors. The photograph also shows the underside of the cooling units which discharge the air into a ceiling duct. The air re-enters the freezer on the left through the slotted baffle and returns to the cooling units having passed over the product. A further picture was taken standing in the –5° store with the partition completely closed. Cooling of this compartment is entirely separate from the freezer, by means of two units mounted at ceiling level one of which can be seen at the top left. If it is desired to use both the storage room, and the freezer as a –5° F. store the partitions are placed in the middle position, one behind the other and the two units then have sufficient capacity to maintain –5° F. and below, in the whole unit, without running the freezing plant at all. In this instance the size of the freezer compartment was based on the maximum daily loading divided by the number of freezing operations carried out per day. Freezing time varied from two to four hours depending on the type of product being frozen. It was found that the temperature in the –5° holding room varied hardly at all despite the fact that three or four loadings of warm goods were put into the freezer per day.

Turning now to the other important factor that is the maintaining of a steady temperature in the –5° F. room, we have, by providing a separate freezer at little extra cost, overcome our biggest problem. We must, however, pay attention to the method of insulating this room against heat ingress, and also provide a suitable refrigerating plant to maintain the desired temperature. Whereas we aimed at a big temperature difference in the freezer, between coil and product, in order to get down as quickly as possible, we do not want this state of affairs in the holding room, for the reasons given earlier. The refrigeration load on the holding room I have just shown you was less than one-third of the freezer load and here the engineer took the opportunity to vary the ratio of size between plant and coil, putting a comparatively large coil on a small compressor, which gave him the small temperature difference he required to achieve the maintenance of –5° F.

Insulating the –5° room and the freezer is most important in order to reduce the heat ingress from outside. Poor insulation will result in wide and rapid temperature fluctuation and at least 8 in. of solid cork or its equivalent must be used. As we saw earlier when dealing with water vapour migration within the store, the same thing will tend to happen through the insulation as soon as a temperature difference exists.

To combat this and prevent the ingress of water vapour into the insulation due to vapour pressure difference, we must seal the outer surface of the insulation by means of a water-vapour barrier. No building materials are completely proof against the passage of water vapour, but if we use about ¼ in. thickness of a good proprietary bitumen, we shall reduce the amount of water vapour entering to manageable proportions. On the other hand we must finish the inner surface of the insulation with a material which passes water vapour freely, in order that any moisture remaining in the insulation can pass inwards to the area of lowest pressure, namely the cooling coils. If our store is over 8 ft. in either length or breadth, we must install some form of heating in the floor construction to combat frost-heave.

I have, so far, confined my remarks to the freezing of baked goods, by which I mean rolls, pastries, etc. There would appear, however, to be distinct possibilities in the freezing of loaves immediately these leave the oven. There is no doubt that in the majority of cases in the wholesale baking industry bread reaches the consumer some 12 to 24 hours after it has left the oven, by which time it can be safely assumed that the staling process is well advanced. This disadvantage, which means that customers never really taste the flavour of fresh bread, can be overcome by freezing loaves as soon as they leave the oven. Other advantages would be the retention of quality permitting distribution from a central point over much larger fields than are possible at present, and the building-up of stocks of bread in cold store to even out production and cut-down overtime and week-end work. As far as the technique of freezing bread goes, this calls for little extension beyond that which I have already outlined to you. It may be that lower air temperatures in the freezer would be advantageous in order to bring into line the freezing time of loaves with that of smaller baked goods. There is no doubt that rapid freezing and for that matter, rapid recovery, would be essential to ensuring a good-quality product. The question of wrapping before freezing would require lower air temperatures to ensure sufficiently rapid freezing and this of course would put up the capital cost of the equipment considerably. There is no doubt, in my mind, that this subject is in the minds of a great many of the larger bakers, who will be weighing-up the pros and cons of bread freezing from an economic point of view.

Recovery

The process of recovery or defrosting depends, in practice, upon the scale on which it is to be carried out, for it is obvious that small batches of goods can be handled very much more easily than large ones. The technique involved is to get the goods back to ambient temperature as quickly as possible with the minimum of condensation being deposited on them. As we all know very well, if we bring a glass of iced water into a warm room, a film of moisture will very soon be deposited on the outside of the glass. This is because the air in immediate contact with the glass has been cooled below what is called its " dew point " and moisture vapour in the air is condensed out on to the cold surface of the glass. We can overcome this state of affairs to a certain degree by recirculating the warm air rapidly past the cold body, or by introducing a fresh supply of warm air, and removing it again before it has had time to cool to its " dew-point." On the other hand we can condition our air, by de-hydrating it first and then warming it up before passing it over the goods. This process would be expensive, and we must be careful not to get the air too dry, or we shall harden the surface of our goods. The ideal set of conditions where a good balance would exist between moisture gain and loss would seem to be about 120° F. with a relative humidity between 50 and 60 per cent.

Two other methods of recovery are in use. In one, goods are transferred to a proving cabinet at 100° to 110° F. and partly thawed. Timing, however, in this case, is fairly critical if moisture loss is to be avoided. The other method is to return goods to the oven for a few minutes to warm up the outside to a temperature above the dew-point of the air. This has the disadvantage of being critical, however, and I am not sure that a certain sogginess might not develop within the goods with this method.

Positive Replacement Rotary Compressors as applied to Refrigeration

By E. J. PERRY, Associate Member, and P. D. LAING, B.Sc.

A paper presented to The Institute of Refrigeration at The Institute of Marine Engineers, The Memorial Building, 76, Mark Lane, London, E.C.3, on Thursday, December 1.

It was felt that there was a place in the refrigeration industry for a compressor having a rotary motion that could compress any of the generally used refrigerants.

Investigating the various methods of compressing gases, the positive displacement rotary screw compressor or the Lysholm compressor, as it is sometimes called after its Swedish inventor, A. J. R. Lysholm, meets many of the requirements of the industry. The compressor was originally conceived to work in

conjunction with gas turbines but it was soon realised that due to its stable properties the compressor could be used for many other applications.

The machine basically consists of two rotors, the male rotor generally having four equally pitched lobes machined helically, the female rotor having six helically machined grooves shaped to receive the lobes of the male rotor. The choice of a (4 + 6) lobe combination was made primarily because this gives rotors of equal stiffness in bending. Other lobe combinations have been used such as (3 + 4) and (6 + 8). The former is suitable for low-pressure applications as it gives a higher volume throughput for the same rotor diameter but the rotors are less stiff in bending. Similarly a (6 + 8) combination is extremely stiff but the specific volume is reduced. Each rotor is machined to give an initial clearance to the other so that when they rotate together they do not touch. Timing gears are fitted to ensure that the relative radial position of the rotors is maintained, that is that there is always clearance between both edges of the driving male rotor and the helical grooves of the female rotor. This clearance enables them to rotate without lubrication.

The lobe profile is of a symmetrical circular arc formation. The earlier lobe profiles that were used were of a generated rotors occurring. This is apparent on the PV diagrams. The next cycle of compression of the interlobe volume being considered is about to occur, although discharge is not complete. This may be compared with valve overlap in a reciprocating I.C. engine. The size of the outlet port is a function of the built-in pressure ratio, a large port corresponding to a low built-in pressure ratio and a small port a high built-in pressure ratio. The built-in pressure ratio does not determine the operating conditions of the compressor but merely the pressure ratio at which the efficiency curve peaks.

The major factors governing the performance of the rotary compressor are the rotor clearances, tip speed, gas characteristics and pressure ratio. It is a feature of the compressor that back leakage or " slip " through the rotors is independent of speed. As the volume throughput varies with speed, the higher the speed the less the proportion of back leakage, *i.e.* the higher the volumetric efficiency. Therefore, tip speeds as high as 200 to 400 ft. per sec. are used which correspond, for example, on 8-in.-diameter rotors to 6,000 to 12,000 r.p.m.

The two principal efficiencies of this type of machine are the volumetric efficiency and the adiabatic efficiency. Volumetric efficiency is the ratio of the suction gas volume actually pumped

An L.P. and H.P. ammonia compressor set coupled to a double-ended motor, this being one of 12 sets having a total of 21,600 h.p. between them.

form which gave slightly better sealing characteristics but were difficult to machine and gauge. Thus the small theoretical increase in leakage area of the circular arc profile is more than compensated by the improved accuracy of manufacture.

The operation of the compressor is similar in principle to that of a reciprocating compressor where the gas is induced into the machine, then compressed and finally discharged.

The female rotor rotates in a clockwise direction looking at the inlet port while the male rotor rotates anti-clockwise. When the two rotors take up different radial positions the interlobe volume is increased, thus inducing the suction gas to fill the void until the inlet end of the lobe passes the extremities of the gas inlet port where the interlobe space becomes a maximum.

The actual volume of gas induced into this space is a function of the geometrical volume of the lobe space and a filling factor. This factor is dependent on tip speed related to the gas characteristics, pressure ratio and clearance.

The authors illustrated how the gas is compressed with a diagram of the rotors with the interlobe space full of trapped suction gas and the male lobe on the bottom rotor just entering the female rotor. As rotation of the rotors progresses the interlobe volume decreases due to the helical length of the lobes shortening and compression takes place. When the rotors reach a certain position (indicated by the authors) discharge of the interlobe space under consideration commences due to the lobe tips reaching the outlet port.

There is no carry over or re-expansion of compressed gas with this type of compressor, complete intermeshing of the to the theoretical displacement volume of the rotors and leakage across the rotors principally determining this value. In this type of machine the volumetric efficiency has far more bearing in the power input than the corresponding efficiency has with reciprocating machines as any back leakage has to be recompressed.

The adiabatic efficiency is a function of both the leakage losses which is the major factor of volumetric efficiency and the aerodynamic losses. The leakage losses decrease with an increase in rotor speed, while the aerodynamic losses increase with an increase in speed.

For controlling the mass flow, throttling of the suction gas has been employed, the degree of throttling at the moment being dependent on the type of refrigerant used, pressure ratio and pressure difference. These restrictions have been overcome and complete unloading can be achieved with the latest design of machine, details of which we are not at liberty to illustrate. With throttling of the suction gas, the power consumption is decreased, the degree of reduction depending upon the refrigerant used and operating pressures. At the present the machines are limited to operate with a maximum pressure difference of 120 lb. per in.^{2}. This limitation being due to bearing loads and rotor deflection. The bending load is due to one side of the rotors being subjected to suction pressure, while the pressure interposed on the other side varies from suction to discharge pressure. These pressure differences also create a thrust load to the rotors, the load being applied from the discharge end and is carried by Michell thrust bearings.

Mr. V. J. Lewis has been appointed home sales manager (Refrigeration Division) of **Teddington Refrigeration Controls Ltd.**, in which position he will be responsible for all U.K. refrigeration control contracts. Mr. Lewis, who is already familiar to many members of the refrigeration industry, has been with the Teddington Group of Companies for 22 years, during which time he has been concerned both with the production of automatic controls and, in recent years, technical sales.

* * *

J.C.P. Industrial Clothing Ltd. have now marketed a completely new range of light-weight nylon aprons. These new aprons are completely resistant to fats, oils, solvents, grease, water, etc. Thorough tests have confirmed that the apron withstands the most severe working conditions—whilst the favourable reception received from the employees who wore the aprons embraced the special design which affords comfort and freedom. These aprons are fitted with standard reinforcement patches, and nylon tie-tapes for extra strength. The large size of this apron weighs only a few ounces—yet the high resistance to abrasion and tear strength is far superior to the more common aprons of P.V.C. and rubber, and more economical. They are available in a range of colours.

Mr. V. J. Lewis.

Automatic Store Door

(*continued from page* 1253)

with a friction disc that will slip in the event of failure of the limit switches, of which one is fitted to control the closing position and the other to control the opening position.

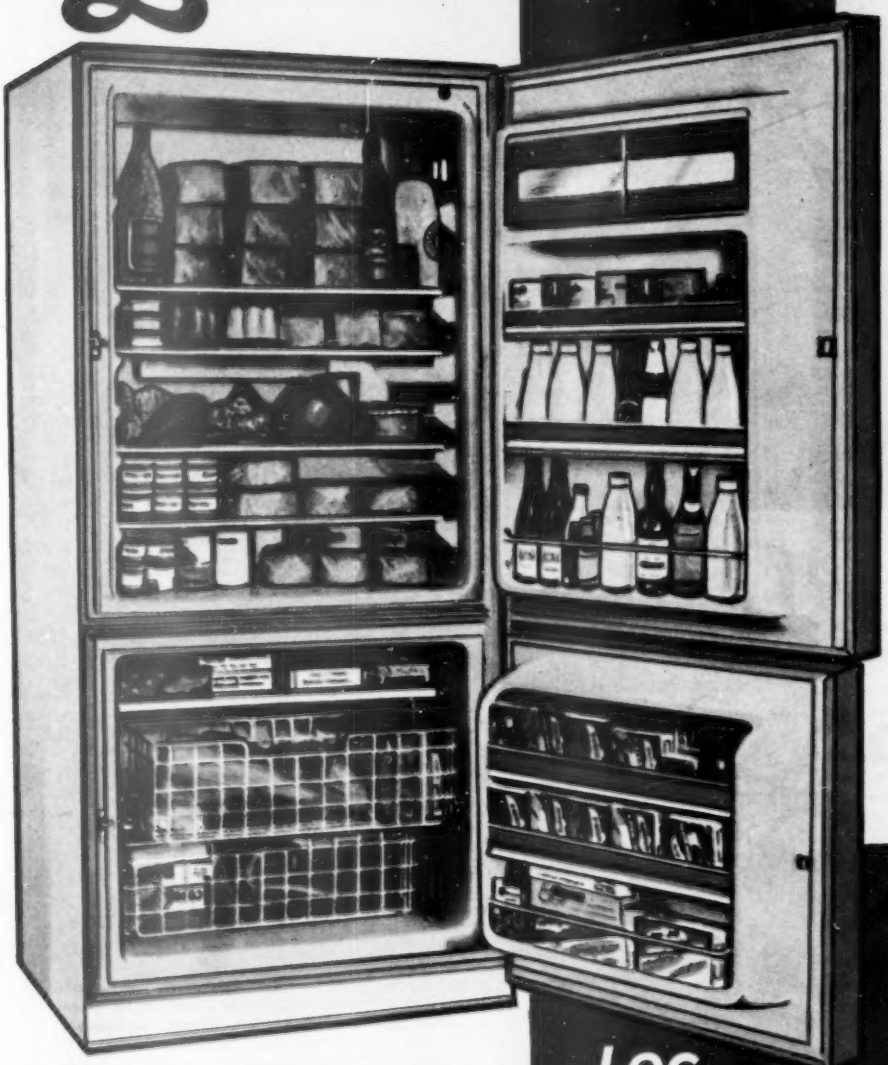
Situated near the four corners of the door are four arms, each carrying a roller, that fit into four corresponding tracks, the rollers in turn guide the door to its closed position in approximately 3 in. of travel into contact with the gasket seal. When this takes place the four corners are locked each with a spring loaded catch that prevents the door from moving off the gasket seal, the principle of which will be explained later. In the reverse action, that is opening the door, this spring catch is tripped, allowing the door to move outwards off the seal to a clearance of approximately $\frac{3}{4}$ in., then travels to its full opening position parallel with the face of the door frame.

The door is suspended from supporting brackets situated at the top corners which travel on rollers along a fixed supporting joist or girder. The mechanical action that operates the door on and off the seal will now be described more fully. The four arms (already referred to) each carrying a roller fitted in a horizontal position are situated near the four corners of the door. As the door approaches to within approximately 3 in. of the closing position each roller comes into contact with a guide plate with a machined track or arcuated slot that guides the door to the gasket. During the last $\frac{1}{2}$ in. of travel a second roller situated above the aforementioned guided roller comes in contact with a spring loaded catch and when the door is actually in contact with the seal this catch plate trips behind the above roller which holds the door securely on to the seal and prevents any outward movement, thus maintaining a constant pressure. The radial face of this catch operates on the same principle as two rollers placed on a horizontal plane, the circumferences of which are in contact with one another. If a thrust is applied in a line through the centre of these two rollers and the securing pin of the catch plate then no movement can take place. During the commencement of the opening of the door the guide roller is pulled at right angles to the imaginary centre line mentioned above, sufficient to eject the catch roller. The guide roller is then free to travel along the track plate until the door is given sufficient working clearance to travel to the full opening position, without coming into contact again with the felt or rubber gasket. Again referring to the seal ; the door frame can be fitted with either aluminium or steel facings, behind which is fitted a heating element. The gasket is fitted around the inner face of the door about the two vertical sides and top to a width of 4 in. or so but the bottom seal is situated under the door frame and the heating element is fitted under a metal plate fixed to the concrete floor. From this description it is clear that the design of the door and frame is what is commonly known as " super-freeze " type but with a slight difference. Where the traditional super-freeze type door is fitted with a wooden taper sill to effect a seal with the gasket under the door, in this design we have discarded the wooden taper sill and fitted a flat plate inserted into the concrete but raised up off the concrete face in the region of $\frac{1}{4}$ in. We designed this modification because it was found in practice that the wooden taper sill would not stand up to the heavy palletized loads involved and after a few months of constant use the wood showed considerable wear and a certain amount of spring. Where the wooden sill had a taper of approximately $\frac{1}{2}$ in. across the 6 in. face the metal plate now installed has only a rise of $\frac{1}{4}$ in. with the front and back faces tapered, thus giving a much smoother passage through to the door-way. To give floor clearance the door supporting joist or beam is slightly raised at one end and the door actually slides up an inclined plane during the opening operation.

Since fitting these sliding doors practical experience has shown that we can now transfer from the store to the loading bay, or visa versa, 25 tons per hour with one man operating the reach truck and one operating the pallet truck with little or no increase in room temperature.

There is also a psychological gain; the operator or storeman now closes the door automatically, whereas in the past this operation was done with reluctance.

A £esson in Lecconomics



We can think of a score of reasons why the dual-purpose S.18 is a vital addition to every store, hotel and canteen.
To name the most important...

it's today's finest refrigeration value!

- Price: only £179.10.0 **INCLUDES 12 MONTHS SERVICE FEE OF £10**
- **12.1 cu. ft. normal refrigerated storage space PLUS . . .**
- **6 cu. ft. deep freeze storage — holds 210 lbs. frozen food**
- **Adjustable door storage**
- **Slide-out freezer baskets**
- **Castor mountings for easy movement**

This is the quality-built commercial refrigerator that you have been waiting for. A superb dual-purpose refrigerator that is a delight to the eye — a pleasure to use. Take a closer look at the Lec S. 18. **COLOSSAL CAPACITY YET OCCUPIES SO LITTLE FLOOR SPACE.**

Thermostatically controlled Vertimetic Unit. Sealed in steel, oiled for life, this power unit has a remarkably low current consumption. Radio and television interference-free.

The newest achievement by Lec

BRITISH MADE THROUGHOUT

Full range of our products can be seen at our London Showroom

217, REGENT STREET, W.1. Tel. REGent 6607

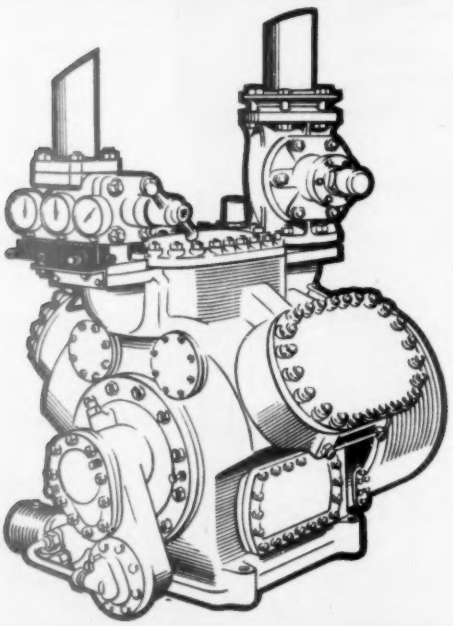
Post this coupon today! *To:* Lec Refrigeration Ltd., Bognor Regis, Sussex.

Please send me full details of the Lec S. 18 and other commercial cabinets.

NAME _____

ADDRESS _____

LIGHTFOOT



COMPRESSORS

A complete range of multi-cylinder semi-radial and vertical compressors is available in all capacities and suitable for use with Ammonia and Freon refrigerants.

A series of informative brochures describing in detail the wide range of Lightfoot standard equipment is available to executives, on request.

LIGHTFOOT
REFRIGERATION

COMMERCIAL AND INDUSTRIAL SECTION

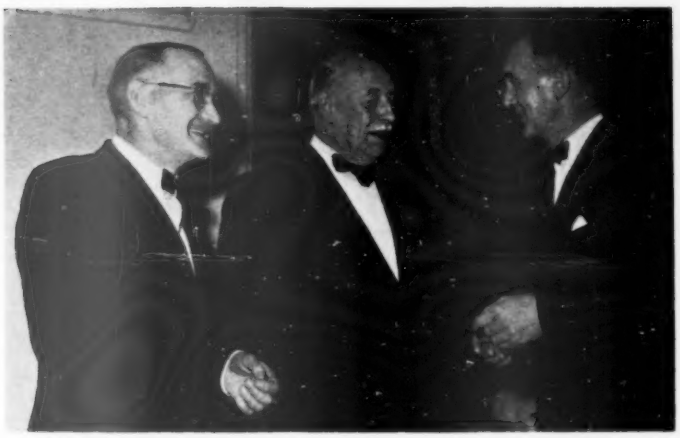
Manufacturers' and Distributors' News

Mr. P. B. H. Brown, managing director of L. Sterne & Co. Ltd., who has been appointed chairman of Worthington-Simpson Ltd.

Mr. Brown is also a director of the Glasgow Chamber of Commerce and a member of the management board of the Engineering Employers' Federation.

* * *

Monsanto Chemical Company of St. Louis and American Viscose Corporation of Philadelphia has announced that negotiations are in progress for the acquisition by Monsanto of Viscose's entire interest in the Chemstrand Corporation, namely Viscose's 50 per cent interest in both Chemstrand's stock and Chemstrand's subordinated notes,

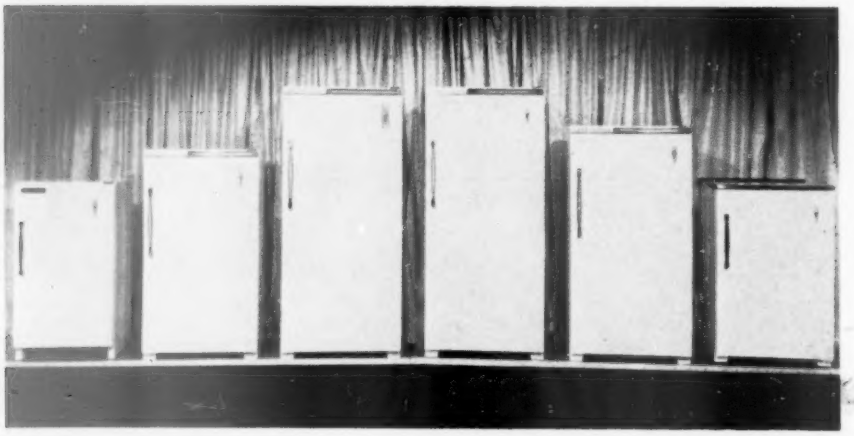


Sir Harold Wernher, chairman of Electrolux Ltd., talks with Mr. George Hughes (left), technical manager, and Mr. Maurice Aitken (right), secretary, after presenting them with gold badges for long and distinguished service. The presentations were made at the company's annual sales dinner and dance at Grosvenor House last month.

★

Morphy-Richard's trading policy is to continue using the wholesaler channels as a method of distribution to the retailer and consumer. This was stated by Mr. W. Roxburgh, a director of Morphy-Richards Limited and managing director of Morphy-Richards (Astral) Limited, at a meeting of distributors in London last month. This policy was re-emphasized by Sir Joseph Lockwood, chairman of E.M.I., and who is now also chairman of Morphy-Richards, when he addressed the distributors at a luncheon following the meeting. In this photograph, Sir Joseph is seen speaking at the luncheon. On his immediate left are Mr. Roxburgh and Mr. E. J. Beaver, joint managing director of the Sun Electrical Company Limited. On Sir Joseph's immediate right is Mr. D. W. Morphy and next to him is Mr. J. E. Wall, managing director of E.M.I. and now also on the board of Morphy-Richards Limited.

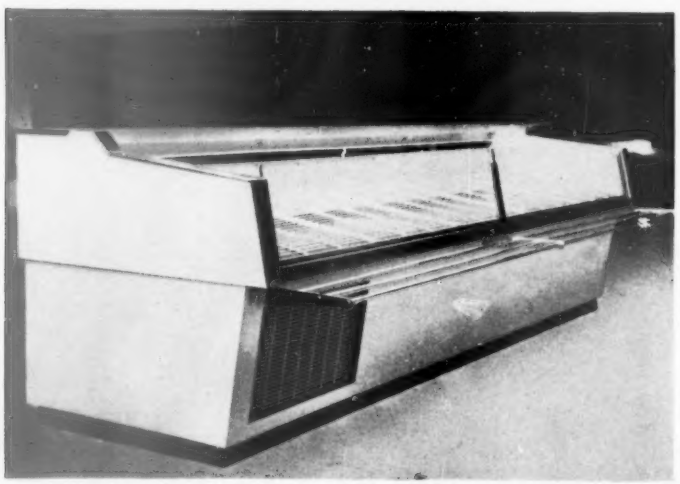
which are estimated to amount to $9,500,000 at the time the plan would be consummated. Under the proposed plan, Viscose would receive 3,540,000 shares of Monsanto common stock which would be subject to special voting provisions so long as they are held by Viscose. However, Viscose has no intention of distributing or disposing of the Monsanto shares at the present time. Prior to the consummation of the plan, it is contemplated that Chemstrand will pay its usual annual $5,000,000 dividend, one-half of which will accrue to Viscose, and redeem $2,500,000 of its $12,000,000 subordinated notes, now held by Viscose. The plan would be subject to approval by stockholders of both Viscose and Monsanto. After the proposed transaction is approved and effected, Chemstrand will continue its activities as a separate entity. The Chemstrand Corporation, which is the world's second largest producer of chemical textile fibres, has a British subsidiary, Chemstrand Limited.



KELVINATOR
1961

Kelvinator's 1961 range: from left to right, Lady K, K60M, K94MD, K94M, K77M, K46ZP.

NEW COMMERCIAL CABINETS



Frozenaire Ltd. of Ten Bell Lane, Norwich, now build a wide range of refrigerated display cases, cabinets and counters and an example of the former is illustrated herewith. They also specialize in walk-in coolers, reach-in refrigerators and blood banks, to mention a few of their lines. These items are solidly built with timber frames while the glass fibre insulation is sealed with kraft paper. "Darvic" p.v.c. is used as cladding in most instances while "Formica" is employed for the back-wrapping of the shelf or display area. "Sternetic" refrigeration units are fitted.

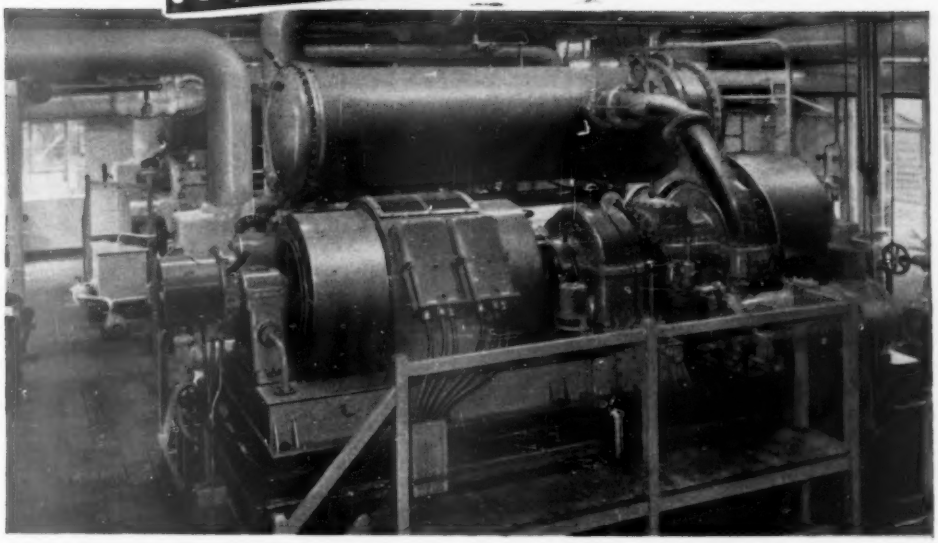
* * *

THE MOSCOW TRADE FAIR

An impressive indication of the importance of Anglo-Soviet trade will be the **English Electric group** stand at the Moscow Trade Fair next year (May 19 to June 4). In their appliance section will be shown a full range of refrigerators from the small 2·7-c.ft. unit that can be built in or tucked under a working top to the 36-in.-high table-top models and large family models of from 7 to 9 c.ft.

Prestcold will be among the major refrigerator manufacturers from this country to show their equipment at the forthcoming British Fair at Moscow. Six Russian-language students from universities in this country have been chosen by the company to act as interpreters. It is thought that much of the Prestcold equipment which will be shown—it includes models from their completely new 1961 "Packaway" range of domestic refrigerators—will be ahead of that currently being manufactured in the Soviet Union.

1,350 TONS of REFRIGERATION for KODAK Ltd.



The illustration shows one of the three CENTRIFUGAL REFRIGERATING MACHINES supplied and installed by J. & E. Hall for the Harrow (Middlesex) Works of Kodak Ltd. They are used for controlling temperature and humidity during the processing of their products. With a total b.h.p. of 2150, the machines have an output of 16,200,000 B.t.u./h—equivalent to 1,350 tons of refrigeration!

J & E HALL LTD

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Refrigeration, Lift and Escalator Engineers

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AP 378

MINIKAY INTERNATIONAL

Minikay Limited recently felt really "on top of the world" when they had an international meeting of all their overseas agents who are engaged in marketing their well-known Miniveil air curtain units. The meeting took place in the roof restaurant of the Atlanta Hotel, Rotterdam. The whole banqueting hall was booked for the meetings which took place on November 10 - 12. Representatives came from Norway, Sweden, Germany, France, Belgium, Holland, New Zealand, Switzerland and Great Britain, and a very lively and productive flow of ideas emerged from the meetings which were arranged at a time to coincide with the reading by Mr. W. R. Michael, B.Sc. (Eng.), A.M.Inst.R., of his paper "The practical applications and possibilities of air curtains." This was done on November 11 at the University of Technical Science in Delft before the Dutch Society of Coldtechnic. Standing, left to right, are: E. Reimers, Sweden; G. Sandberg, Sweden; P. van der Leeden, Holland; A. O'Connell, France; H. Franzen, Germany; W. Knapp, Germany; Johs D. Furst, Norway; W. R. Michael, Gt. Britain; T. Kopp, Switzerland; B. W. Symington, New Zealand; H. Scheltema de Heere, Holland. Sitting, left to right, are: R. Douek, France; H. P. Creek, Gt. Britain (secretary); E. C. Goldsworthy, Gt. Britain (chairman); R. Sterkel, Germany; G. E. Jennings, Gt. Britain (gn. manager); G. Daelmans, Belgium; Mr. Wirth, Germany.

Miss Phyllis E. Grady has been appointed housecraft adviser home economist to Morphy-Richards, where she will assist in the develop-

ment of new products and in the general promotion of new and existing appliances. She will also engage, train, and manage a team of lady demonstrators who will promote the company's domestic electrical appliances throughout the country.

* * *

Nine main product ranges are now marketed in Britain by the Special Products Division of **Chrysler International S.A.**, Region Two, from its Kew, Surrey, factory. The ranges are :—(1) Radial condensing/compressor sets—15 to 100 h.p. with water cooled and evaporative condensers ; (2) radial compressor—chilled water and brine coolers, 25 to 100 h.p. ; (3) serviceable sealed condensing units, 7½ to 30 h.p., water and air cooled ; (4) hermetic condensing units, 3 to 7½ h.p., water and air cooled ; (5) evaporator blower units, 3 to 30 tons refrigeration plus complementary air handling units ; (6) liquid chillers water and brine, 3 to 100 tons refrigeration ; (7) packaged air conditioners, hermetic and serviceable sealed compressors air and water cooled, 3 to 30 h.p. ; (8) packaged air conditioners, radial compressors, water and evaporative condensers, 25 to 75 h.p. ; (9) hermetic and serviceable sealed compressor, 3 to 15 h.p., for manufacturing projects. Of particular interest, the Chrysler-Airtemp radial compressor incorporates a capacity regulator and starting unloader which automatically keeps the pressure capacity and the varying loads in perfect balance at all times. Unloaded starting permits the use of a standard low-starting current, normal torque motor. All bearing surfaces as well as the refrigerant shaft seal are pressure lubricated, assuring long dependable life to the compressor. The compressor itself is connected directly to the electric motor, permitting higher speeds, eliminating belts and flywheels and resulting in more tons of refrigeration per horsepower. The dynamically balanced crankshaft is surface hardened to provide long wear and perfect performance and operates in precision finished bearings of replaceable type. The unique design of the low resistance oil separator increases the efficiency of the system by reducing the oil content in the refrigerant below two-tenths of 1 per cent. The refrigerant shaft seal is pressure lubricated and requires no adjusting. The large area non-flexing valves allow an easy flow of gas with high volumetric efficiency which permits high speeds and provides long life.

SHOP REFRIGERATION NEWS

Large-Scale Self-Service

By Our Special Correspondent

ITS EFFECT ON CABINET DESIGN

I CAN ONLY hold my job down on this journal by operating on a Vicar of Bray basis. One month I pay lip service to big business by reviewing refrigeration progress in the supermarkets ; another month—and this was examplified in the last issue—I show what refrigeration is doing to help the small retailer to fight big business.

But the vacillating vicar stuck to his job at which—knowing of no evidence to the contrary—I assume him to have been reasonably and consistently competent. My own practices of swinging from one side to another are, I hope, equally, no deterrent to efficient reporting.

But I am modifying the oscillations this month because, for purposes of comparison and, in order to illustrate the points I am making, it is necessary to show examples o both classes of shops.

I am returning this month to large-scale self service : not to explain how much it is being helped by refrigeration but rather to indicate what self service is doing for refrigeration, and then to ask : Is it setting a high enough standard ? Are its methods of usage all that they should be ? Is the space allotted to refrigerated display and storage as large in proportion to the size of the store as one might reasonably expect it to be ?—questions I propose to leave unanswered for the time being.

Left: At Anthony Jackson's Foodfare, Church Street — two 12-ft. Cascade cabinets back to back for fats and cheeses.

Right: 12 ft. Hussmann delicatessen counter, stainless steel trims and 12 in. rear "Formica" topped serve - over counter, at the same address.

Two Cascade cabinets, back to back, for cooked meats and poultry, at Anthony Jackson's Foodfare.

24 ft. Cascade cabinet for pre-packed meats in the same shop.

West Foodstores supermarket, Walton-on-Thames. Partial view of 31 ft. twin department dairy frozen foods case, showing the 16 ft. three-deck dairy section.

West Foodstores supermarket's 24 ft. "Mass Display" case for pre-packed fresh meats.

It may be said that the last question is no concern of the makers of refrigeration equipment: that they design cabinets to meet the requirements of their customers the retailers.

Let us look at the refrigerated display facilities in two of the latest supermarkets: West's Food Stores at Walton-on-Thames, and Anthony Jackson's at Church Street, Edgware Road, London. The former has a 90-ft. run of refrigeration for a selling area of from 2,500 to 3,000 sq. ft., and the installation comprises (1) 31 ft. of dairy produce/frozen foods. This is a twin department cabinet of the type which MODERN REFRIGERATION illustrated, a new Hussmann development, last month (page 1,164) this provides 16 ft. for dairy produce display and 15 ft. for frozen food display, (2) one 12-ft. poultry cabinet, (3) one 12-ft. Cascade cabinet for cooked meats, and (4) one 24-ft. run of single-tier display for fresh meat.

At Anthony Jackson's, with a selling area of 8,850 sq. ft., there are two sets of 12-ft. long Cascade cabinets set back-to-back, as well as a 24-ft. long three-decker for pre-packed meats, and a particularly impressive delicatessen counter with a laminated plastic surface at the back serving the three purposes of displaying non-refrigerated merchandise, weighing and serving.

Although it is not a supermarket, Sainsbury's new self-service store in Edinburgh Street, Portsmouth, is said to be the biggest food store in this country. It has 8,250 sq. ft. of selling space, and 26,636 sq. ft. of total floor space.

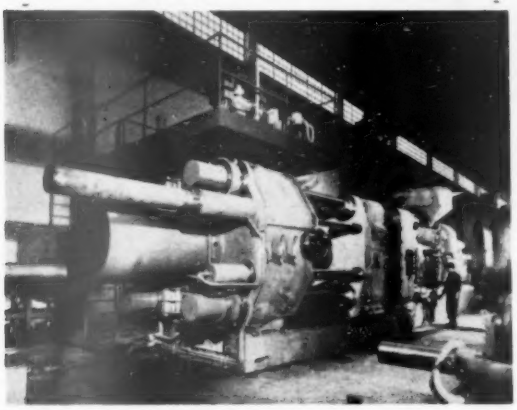
The refrigeration installation here included a service meat department which comprises a staff-attended line of five tall glass-fronted cabinets from which customers make their selection and over which service is given. The cabinets alternate with scales which form an integral part of the design of the complete assembly. All these cabinets were supplied by K. J. Levin, are equipped with a double row of display trays in stainless steel on a stepped bottom plate, a chromium-plated grid shelf at higher level, and built-in fluorescent tubing.

The total length of refrigerated display is 168 ft. This consists of 40 ft. for service meat, 40 ft. for self-service meat, 24 ft. for poultry, rabbits, and game, 24 ft. for cooked meat and sausages, 16 ft. for frozen foods, and 24 ft. for butter and fats.

An important part of the refrigerated storage system is a battery of 24 lockers used for holding ready-wrapped meat and provisions which have been prepared and packaged on the same floor. The wrapped products placed on plastic trays are passed into the lockers at one end and travel through on tracks made of perforated angle-bars. They are withdrawn at the other end of their respective lockers as required in the shop.

World's Largest Injection Moulder

SAID to be the largest and most powerful of its kind in the world and having an injection capacity of 425 oz. and a clamping force of 2,500 U.S. tons, an injection moulding machine has been produced by Triulzi of Milan. The first three units have been ordered by a German firm for the production



of refrigerator liners. Output is high at the rate of one liner every two minutes and the unit is ideal for producing large household articles.

The machine is manufactured for automatic cycle but every movement can be controlled separately by means of push-buttons. The injection force can be adjusted up to a maximum of 220 tons and with a standard injection plunger it is possible to obtain up to 22,000 lb. per sq. in. With this pressure and with very high injection plunger speeds it is possible to process any thermoplastic material and obtain thin-walled mouldings.

The body of the machine is cast in steel with rolled steel sections in the bedplate. The rams and tie-bars are ground and hard chrome-plated. Steel and special materials have been used for the sliding parts and components under stress. The hydraulics, valves, distributors and servo-controls are located on an accessible platform fitted over the reaction head. All the electrics, timers for setting time, electronic readings and automatic controls of the temperature are located in a special sheet-sealed box to protect them from dust and temperature variations. All the electric equipment is separate from the machine so that no possible vibration can affect them.

Triulzi machines are available in this country and the Commonwealth through Baker Perkins Granbull Ltd., Kingston-on-Thames.

Modern Refrigeration is obtainable from the manager, Maclaren House, 131, Great Suffolk Street, London, S.E.1, at thirty-five shillings per annum post free to any part of the world.

The new factory at Irwell Bank Mills, Stoneclough, Radcliffe, near Manchester, of A. J. Flatley Ltd. Flatley's refrigerator has been described as "the most fantastic Flatley of all." This cabinet contains over 4½ c.ft. of storage space. Refrigeration is by the internationally famous "Sternette" sealed compressor unit and yet retails at 39 guineas.

BRITISH FAIR IN MEXICO CITY

Sir Norman Kipping, J.P., director-general, Federation of British Industries, presided at a press conference to announce a series of specialized trade fairs jointly sponsored by the F.B.I. and the Dollar Export Council and organized by British Overseas Fairs Ltd., to be held in Mexico City, Sept.-Nov., 1961. The fair would be a "gateway to a £400,000,000 market," said Sir Norman.

Centrifugal Refrigeration Systems in the Production of Chemicals for Plastics Materials

By ING. OLDRICH CERVENKA
CKD Praha, Czechoslovakia

This article was received too late for presentation at the Xth International Congress of Refrigeration in Copenhagen last year and we have pleasure in presenting it, owing to its great topicality, in these columns.

The rapid expansion of the chemical industry during the last few years has led to an increasing demand for industrial refrigeration systems for most varied levels of temperatures, with the capacities installed in one equipment rising steadily. This trend manifests itself most distinctly particularly in technological processes of basic chemicals for the production of plastics and synthetic materials, i.e. in the production of acetylene, ethylene, propylene, etc. Similarly, in other technical branches, there is a strong trend in the chemical industry to still higher capacities per unit with a high degree of automation of the process. As a consequence of these technological requirements, there is a demand for refrigeration systems for still higher capacities per unit installed. For example, in one of the recent projects the required capacity of one unit was 1,300,000 kcal/h at –110°C. evaporating temperature. This creates favourable conditions for a still wider application of centrifugal refrigeration systems which, at this level of output, best comply with the demand for a small number of units and, at the same time, create conditions for a high degree of automation.

Introduction

1. Application of centrifugal refrigeration systems in the industry of plastics and synthetic materials.

In the technological processes of basic chemicals for the production of plastics and synthetic materials, most varied requirements for refrigeration systems are encountered with. From the viewpoint of temperature levels, these requirements can be classified into roughly five principal groups listed in table 1. where data are given for the individual equipment groups as concerns purpose and sphere of application, the top limit of capacities hitherto required for one system, the types of circuits, refrigerants and type of equipment used.

It is evident that even when using ammonia, that is a refrigerant with a high volumetric refrigerating effect, the use of centrifugal refrigeration machines is already possible and economically favourable.

Similar situation is found in group 5, where the outputs required will again necessitate the use of centrifugal machines.

TABLE 1. PRINCIPAL GROUPS OF REFRIGERATION SYSTEMS IN THE PRODUCTION OF CHEMICALS FOR PLASTICS MATERIALS

Group	Evaporating temperature level °C.	Purpose of refrigeration system	Top limit of capacity hitherto required for one system kcal/h	Type of cycle	Refrigerants used	Types of systems used
1	+12 to +5	Mostly indirect refrigeration for cooling water	20,000,000	one-stage	F 12 F 11 NH_3 H_2O	P, T T P, T, A E, A
2	0 to –25	Mostly indirect refrigeration for cooling brine (*e.g.* NaCl, $CaCl_2$, $Ca(NO_3)_2$), ethylene glycol etc.) or direct refrigeration for process duties	20,000,000	one-stage two-stage	NH_3 F 12 F 22 Propane Propylene	P, T, A P, T P T T
3	–30 to –50	Mostly refrigeration with direct expansion of refrigerant in process heat-exchangers or indirect refrigeration for cooling brine	20,000,000	two-stage three-stage	F 12 F 22 NH_3 Propane Propylene	P, T P P, T, A T T
4	–60 to –80	Almost exclusively refrigeration with direct expansion of refrigerant in process heat-exchangers	2,000,000	three-stage cascade	F 12 F 22 Ethane-NH_3	P, T P P
5	–90 to –110	Refrigeration with direct expansion of refrigerant in heat-exchanger process	1,500,000	cascade	F 13-F 12 Ethylene-NH_3 Ethylene-propane Ethylene-propylene	T P T T

Symbols : P—with reciprocating compressors ; T—with contrifugal compressors ; A—absorption system ; E—ejector systems.

This is No 1 in a series of advertisements by
STAL Refrigeration AB

The rapid development which has characterised refrigeration during the past decade would have been impossible without the modern refrigeration industry.

STAL Refrigeration AB—a company in the de LAVAL LJUNGSTROM group — have contributed to this development in no small way.

STAL, with customers all over the world, is now one of Europe's leading makers of industrial refrigeration equipment, well known for versatility and employing specialists in every section of the refrigeration field.

Some examples:

■ STAL is the leading supplier of ship's refrigeration plant (10,600,000 cu.ft. delivered in 1959). These marine installations meet Lloyd's requirements.

■ STAL was responsible for two of the biggest artificial ice rinks in the world — Ullevi in Gothenburg (84,500 sq.ft.) and Rocklunda (73,500 sq.ft.).

■ STAL tube ice machines — for ice purer than drinking water — are now working on the Continent in the service of the fishing industry.

■ STAL has built most of the chlorine liquefaction plants in Sweden and many of those abroad — plants for the liquefaction of PVC and similar applications.

■ STAL supplied refrigeration equipment to Northern Cold Storage Ltd. for their great Grimsby warehouse with a capacity of 28,000 tons of foodstuffs and a volume of 3,180,000 cu.ft. The plant was erected by Helsingborgs Fryshus AB, Sweden.

■ STAL water cooling units are at work in many branches. The high gloss required in the laminating process for the Tetra Pak cartons is in many foreign packaging factories achieved through the application of STAL water chillers.

■ STAL air conditioning is found all over Europe and also in such distant countries as Mexico, Iran and Pakistan.

■ STAL Refrigeration plants are in use in many other countries: in Brazil, for freezing meat; at the North Cape, for handling fish; in South Africa, for fruit storage; in Japan, for ice production.

STAL Refrigeration

NORRKÖPING · SWEDEN

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When the problem is the lowering of temperature, it's a matter of cold logic to use 'Arcton' chlorofluorohydrocarbon refrigerants from I.C.I.—the first to introduce this type of refrigerant in Great Britain. (And the people with the greatest experience.)

Not that I.C.I. is resting on its laurels. Behind 'Arcton' refrigerants there's a background of constant research for further improvements. Wherever cooling is the problem, 'Arcton' refrigerants can provide the answer. They're of consistent high quality and low moisture content; and they're non-toxic, non-corrosive and non-inflammable. What's more, there's an 'Arcton' refrigerant to suit *your* need.

'ARCTON' REFRIGERANTS

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

ICI

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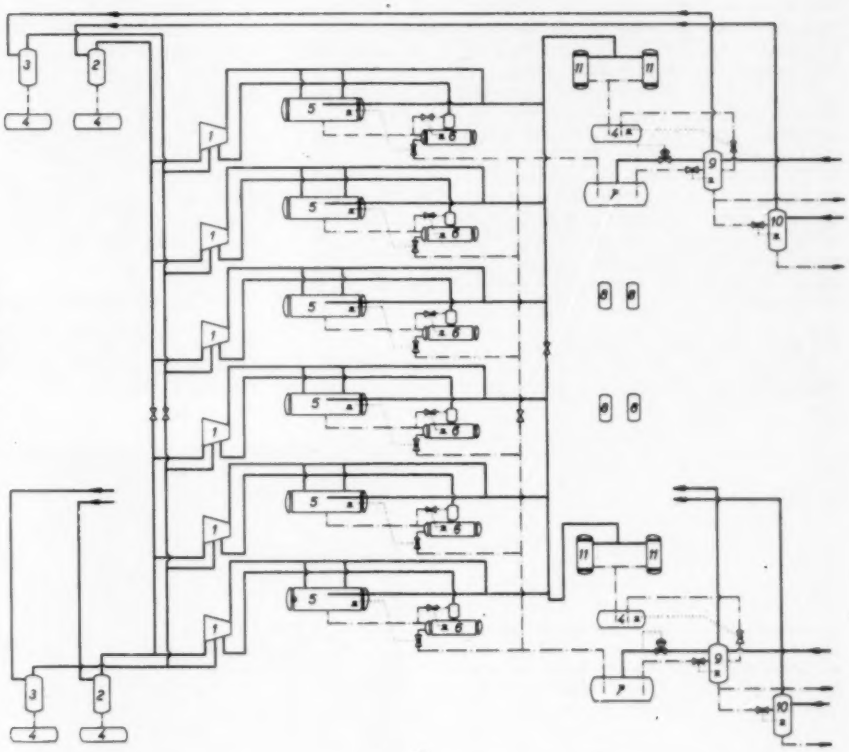


Fig. 1.—Basic flow diagram of the refrigeration plant. This plant works with a mixture of propane - propylene as refrigerant and consists of six independent refrigeration systems, five of which are covering the required capacity and the sixth serving as a standby.

Consequently, one can say that in the branch of refrigeration equipment for the production of basic chemicals for plastic materials favourable conditions are present today for the use of centrifugal refrigeration machines, almost regardless of the kind of refrigerant used.

2. Some problems in projecting centrifugal refrigeration systems for the chemical industry

2.1 Choice of refrigerant

In most spheres of application of centrifugal refrigeration systems, like *e.g.* in air-conditioning, the kind of refrigerant is to a great extent determined by its thermodynamic advantages and suitability from the point of view of design of the compressor and heat-exchangers, as well as by safety regulations. On the other hand, in centrifugal refrigeration systems for the chemical industry the choice of refrigerant is to the greatest extent determined by the technological process, especially in the case of equipment under groups 3, 4 and 5 in table 1, working with evaporating temperatures between–30 and –110°C. The question of safety of the refrigerant is usually of secondary importance.

With a view to the possibility of replacing eventual refrigerant losses with the product streams from the technological process at a very low cost, one mostly uses the chemicals taking part in the technological processes as refrigerants, especially propane, propylene and ethylene as well as ammonia.

" Freons " are used only in those equipments which can work with a small charge of refrigerant, owing to their relatively high price and high cost for replacing the losses. These are mostly equipments composed of refrigeration units for indirect cooling of water or brine, belonging under groups 1, 2 or 3.

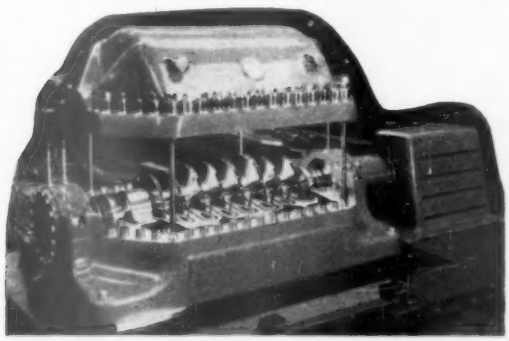


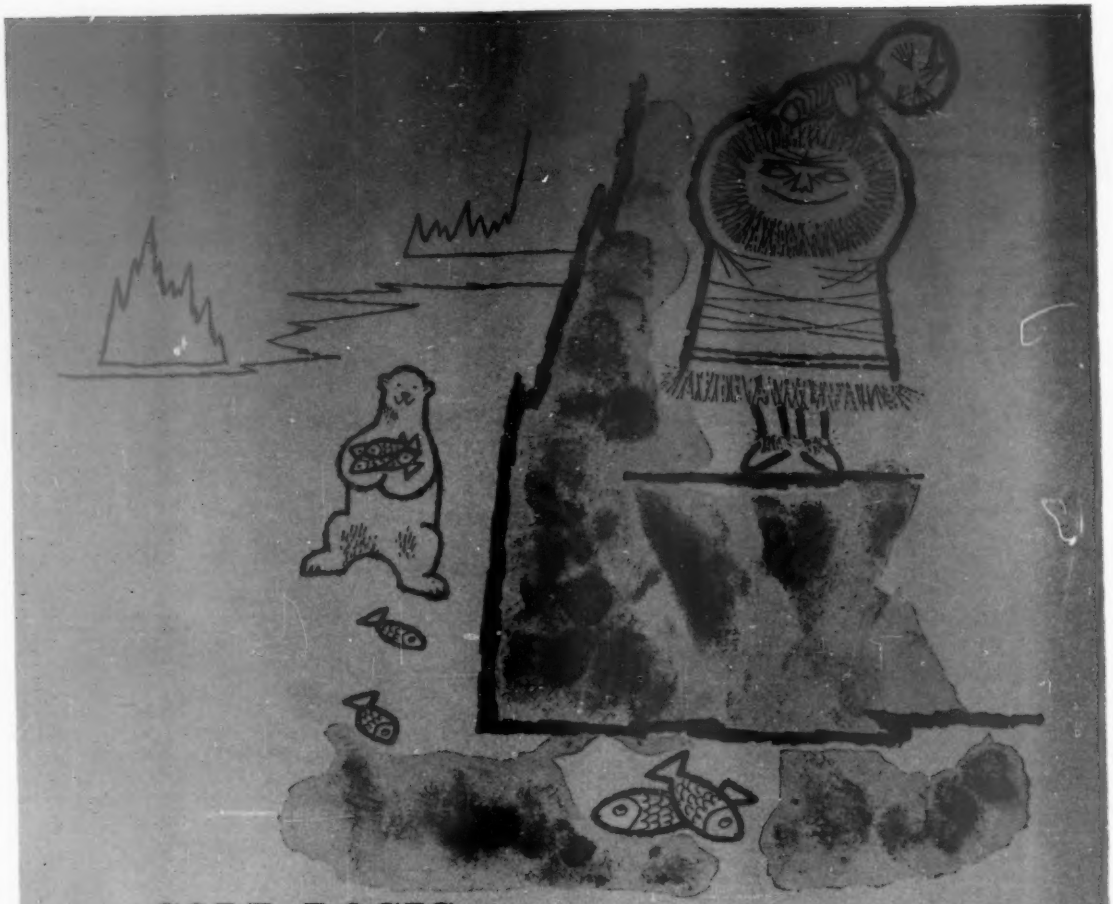
Fig. 2.—Each refrigeration system has a centrifugal compressor of single casing design with eight impeller wheels.

2.2 Design and layout

The design and layout solution is in principle determined by the kind of refrigerant used.

In " Freon " systems, almost exclusively, compact arrangement of the compressor with drive, condenser and evaporator is used. Depending on the temperature levels the compressor is designed as a single-casing unit with one to four impeller-wheels. Finned tubes are preferably used in shell-and-tube condensers and evaporators. These packaged units, usually intended for cooling water or brine, are located in covered machine rooms.

For systems working with carbohydrates or ammonia as refrigerants, the centrifugal compressors are mostly installed in a covered machine room and the heat-exchange units are installed separately, mostly in the open. These compressors are designed as single-casing or double-



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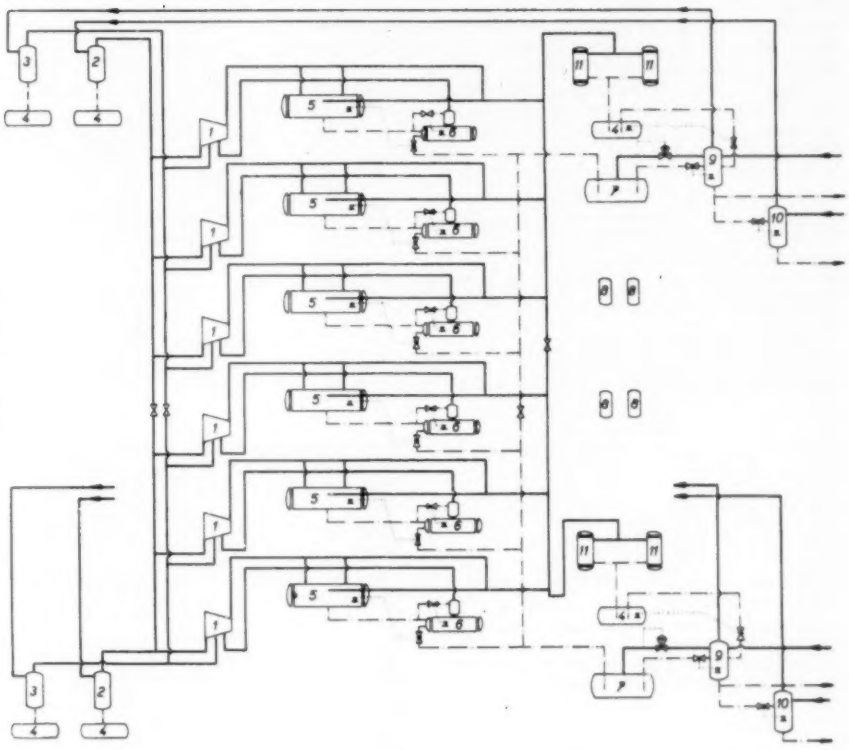

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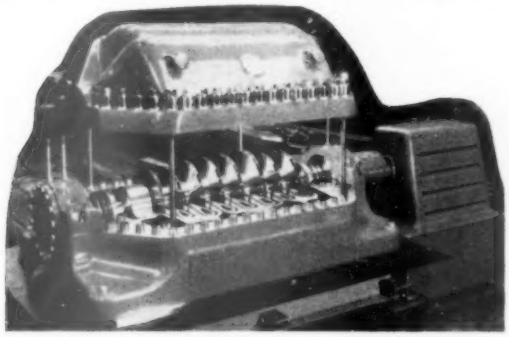

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casing units (particularly for ethylene and ammonia) with 4 to 10 impeller-wheels in each casing. Heat-exchangers are designed almost exclusively as shell-and-tube units with finned or bare tubes.

The drive of centrifugal compressors is mostly by electric motors, steam turbines and recently also by gas turbines. The choice of drive is determined first of all by the cost relation between the individual sources of power at the factory in which the equipment is being installed. In consideration of investment cost the drive by electric motor is most favourable, but from the point of view of energetic balance and of the possibility of economically regulating the refrigeration capacity within a wide range, drive by steam or combustion turbines appears most advantageous.

2.3 Basic diagrams of circuits used

Most common centrifugal systems are those with one evaporation temperature, the circuit being solved, depending on temperature conditions, either with single-stage or two-stage compression and single-stage or two-stage flashing.

Recently there has been a growing demand for systems working simultaneously with two or more evaporating temperatures and the corresponding circuit is designed with two or multiple-stage compression and two or more flashing stages. Systems of this type with centrifugal compressor designed for more than one evaporating temperature bring about considerable savings in weight, investment cost and space required as compared with systems where a separate compressor works for each evaporating temperature.

Although it appears theoretically favourable to utilize in centrifugal compressor systems to the greatest extent the possibilities of multi-stage compression with inter-stage cooling of compressed refrigerant vapours, in reality only two-stage compression is mostly used with one inter-stage cooling. The reason being the requirement for a simple design of the compressor and for a simple solution of the refrigeration circuit, which facilitates automation of operation. For these reasons in systems working with propane, where vapour superheat during compression is small, the circuit is simplified in that vapours from the first stage discharge are not cooled in the flash type inter-cooler to the temperature corresponding to intermediate pressure ; instead, saturated vapours produced by flashing liquid refrigerant into the flash type inter-cooler, are drawn into the suction of the second stage.

Systems in groups four and five are mostly solved as cascade systems. Two-stage compression is mostly adopted in both cycles of the cascade, with inter-stage cooling and two-stage flashing of liquid refrigerant. In some cases where the location of evaporators necessitates liquid refrigerant of higher pressure to facilitate distribution, it appears necessary to replace two-stage flashing of liquid refrigerant by sub-cooling liquid refrigerant in the inter-cooler at full condensing pressure to a temperature almost corresponding to intermediate pressure.

An example of a centrifugal refrigeration plant

Some of the technical solutions of centrifugal systems mentioned in the preceding chapters may be explained in more detail by an example of one of a number of plants already solved.

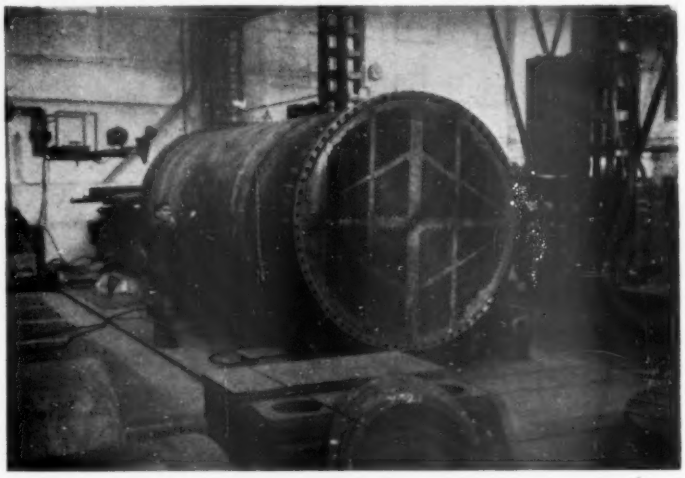

Fig. 3.—The shell and tube horizontal condensers used in the system have a heat exchange area of 1,300m². They are made up of bare steel tubes rolled into tube sheets.

3.1 Main parts of the plant

The plant belonging to the temperature range of −30° to −50° C., in which direct evaporation of refrigerant in exchangers of technological processes is predominating, is intended for covering refrigeration requirements in columns for separating pyrolysis gases, for producing pure ethylene. The plant has a refrigeration capacity of 16,500.000 kcal/h, of which 9,000.000 kcal/h at −30° C. evaporating temperature and 7,500.000 kcal/h at −18° C. evaporating temperature.

The refrigeration plant the basic flow diagram of which is shown in fig. 1, works with a mixture of propane-propylene as refrigerant and consists of six independent refrigeration systems, five of which are covering the required capacity and the sixth serving as stand-by.

Each refrigeration system has a centrifugal compressor, (see fig. 2) of single-casing design with eight impeller wheels. The 2nd-stage suction is introduced into the suction of the 3rd impeller wheel, 3rd-stage suction into the suction of the 6th impeller-wheel. The casing is of simple cylindrical shape. The rotor whose working speed of 6,000 r.p.m. is above the critical speed, runs in two slide bearings accessible during shutdown even at full pressure of the refrigerant inside the casing. For complete sealing of the machine there is one oil seal for running conditions and one rubber seal for shutdown period. Before starting the rubber seal is automatically

released. The compressor is driven through a reduction gear by a synchronous explosion-proof motor of 2,400 kW output.

The condenser *5* of each refrigeration system is of shell-and-tube horizontal type (fig. 3), having a heat-exchange area of 1,300 m² made up of bare steel tubes rolled into tube sheets. Each system includes an inter-cooler *6* and the necessary piping, fittings, measuring and control instruments. Three refrigeration systems have one common liquid a separator *2* in the suction line of the –30° C. circuit, one liquid separator *3* in the suction line of the –18° C. circuit, two liquid accumulators *4* for the mentioned separators, two ethane condensers *11* with pertaining receiver *7*, two purgers *8* and separators *9* and *10* with the evaporators placed in the towers.

The whole plant is equipped with a steam-jet vacuum pump for evacuating the circuit. Suction lines of all systems are inter-connected by one collector in the –30° C.

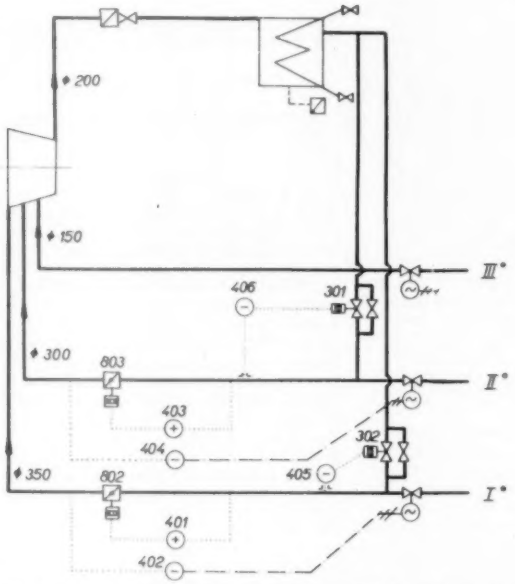

Fig. 4.—The automatic control device used in each system for regulating refrigeration capacity and stopping and starting.

circuit and one in the –18° C. circuit. The discharge lines of all systems are inter-connected by one collector of liquid refrigerant behind the inter-coolers and one collector between the discharge of refrigerant vapours and ethane condensers.

3.2 The refrigeration circuit

The refrigeration circuit was projected as three-stage system with refrigerating duty in the first and the second stages. The vapours produced by the first flashing are drawn into the third stage.

Refrigerant vapours from the tower evaporators working with –30° C. evaporating temperature, first enter liquid separators *2* wherefrom they flow to the suction collector of the –30° C. circuit. Similarly the refrigerant vapours from the tower evaporators with –18° C. evaporating temperature flow first to separators *3* and therefrom to suction collector of the –18° C. circuit. Liquid refrigerant which may collect in separators *2* and *3* is drained into accumulators *4* and therefrom to service receiver *7*.

The first stage of compressor *1* draws refrigerant vapours from the –30° C. collector and compresses them to 2,66 ata, corresponding to the suction of second stage. Refrigerant vapours from the –18° C. collector are also drawn into the second stage. Refrigerant vapours compressed by the compressor are carried to condenser *5* where they condense at 12,46 ata pressure and +35° C., at cooling water temperature of +25° C.

With a view to the parallel operation of several refrigeration systems, high-pressure control of liquid refrigerant is used, where an automatic control valve is governed by an impulse from the level of the liquid refrigerant in the condenser, and regulates the flow of refrigerant from condenser *5* to inter-cooler *6*. Before entering the inter-cooler one part of the liquid refrigerant is by-passed to the automatic control valve governed by level regulator and is flashed into the evaporator space of the inter-cooler to 5,92 ata pressure, corresponding to a temperature of +7° C. Vapours formed in the evaporator space of the inter-cooler are drawn into the third stage of the compressor. In the inter-cooler of horizontal design liquid refrigerant flows through the tubes in several passes and is sub-cooled to +12° C. by the refrigerant evaporating outside the tubes. Liquid refrigerant sub-cooled in the inter-cooler then passes through the automatic control valve to the collector and therefrom to service receiver *7*, where pressure of 7 ata is maintained by an automatic regulator. If the pressure rises above 7 ata the surplus refrigerant vapours are passed to separator *9* of the –18° C. circuit.

From service receiver *7* the liquid refrigerant is further flashed to 2,66 ata pressure corresponding to –18° C. into separator *9*. Part of this liquid refrigerant then flows directly to the evaporators with –18° C. evaporating temperature, placed in the towers and one part is further flashed into separator *10* to 1,7 ata corresponding to –30°C. and flows to the evaporators working at that temperature.

The circuit also includes ethane condensers *11* for evaporating ethane by condensing propane-propylene. The ethane condensers can be fed either by superheated refrigerant vapours directly from the compressor discharge, or by saturated vapours cooled in water condensers *5*.

The individual systems and whole plant are also provided with auxiliary equipments for evacuating and charging the refrigerant, for purging, filtration of refrigerant, for overpressure protection, etc.

3.3 Capacity regulation and automation of operation

All the refrigeration systems are provided with automatic control of refrigerating capacity and for automatic starting and stopping the machine, as shown in fig. 4.

The regulation of refrigerating capacity is of the pressure type and works by maintaining constant pressure before the throttling damper 802 in the suction line of the 1st stage and throttling damper 803 in suction line of the 2nd stage by closing and opening these dampers according to the refrigeration capacity required. Both capacity controls are mutually independent.

Each machine is equipped with anti-pulsation controls 405 and 406 in both stages ; in case of substantial drop of refrigerating capacity, when the refrigerant amount has dropped under a certain limit, it will prevent pulsation by passing part of refrigerant vapours from the discharge to suction by means of by-pass valve 302 in the line of 1st stage and 301 in the line of 2nd stage.

Practically full automation of operation and easier attendance especially during starting is attained by

Continued on page 1285

THE MARSEILLES MEETINGS

Further Extracts from the Papers of the Commissions

(Continued from the November Issue)

A special volume, containing the full texts of papers presented before commissions 3, 4 and 5 at Marseilles, will soon be published by I.I.R. headquarters, Paris.

Problems, Progress and Proposals in Resolving Some of the Confusion on Units in the United States.

By CARL F. KAYAN
Columbia University, New York, U.S.A.

Under the leadership of the engineering section M of the American Association for the Advancement of Science, the problems of the national and international aspects of systems of units have been vigorously explored at the annual meetings held recently in the U.S.A. in Washington (1958) and in Chicago (1959). It is a pleasure to report that these programmes have somewhat been the outgrowth of the inspiration to the author from his colleagues abroad, and particularly those who have been members of the Institut International du Froid. In these programmes comprising well over 50 papers, there have been numerous contributions from overseas authors ; this may be seen from the proceedings of the Washington symposium which have already been published[1]. At the recent meeting in Chicago, Mr. Walker L. Cisler, president of the American Society of Mechanical Engineers (and in private life the president of a large national power system, the Detroit Edison Co.), keynoted the four-session symposium with a spirited reminder of the urgency for the solution of the problems stemming from the diverse conventions for measurements as used in the world today. He aptly pointed out that much progress had been made throughout the world in the fields of economic and political understanding, but that much remained as concerned units and the confusing situations that were involved : " Although the laws of nature that we study and exploit for human betterment are the same for every nation, we speak in different languages, and more particularly, we are at variance in our choice of technical terms and *units of measurement*. We are gathered . . . . to focus upon and to scrutinize this problem of removing barriers to communication in the expression of measurements." But let us look at this problem of units for the U.S.A. in both a general and specific way, as concerns both the public as well as the technological aspects. It is well known that the hundredweight (cwt.) is one hundred pounds, that one gallon of water equals four quarts of two pints each, and since " a pint is a pound the world around," this makes the gallon weigh about eight pounds. Yes :— substantially true for the United States of America, but quite untrue for the United Kingdom. For there, as everyone over there knows, the hundredweight (cwt.) is 112 pounds, and the gallon, 10 pounds. But . . . " Do not the British and the Americans both use the English system ?" is the question asked. Ah yes, in general, but there are differences . . . Beauty contests on the European continent could be most confusing to an American visitor skilled in appreciation of a perfect " 36 " when confronted with a number such as " 90 " ; to discover that his sports car has a 145 × 380 tyre ; or to learn that he weighs 82 in place of 182. Then he is reminded that these values are quoted in the " metric " system, whereas he grew up under the " English " system. Or perhaps he suspects, on getting over to the Continent, that he has developed a fever, and at his hotel the concierge produces a clinical thermometer which mystifies him with a 37·0° reading, but his American friend over there finally produces his family thermometer which reads indeed a reassuring 98·6° F. value.

We may well recognize that ultimately international interchange of technical information would be greatly facilitated by the adoption of a universal system of units, by ultimate changeover to some metric system. But obviously the *economic* consequences of industrial and public changeover, from an Anglo-American to a metric system, would be colossal. From the industrial viewpoint, ample evidence on the tremendous changeover costs can be cited[2]. To these costs must be added the problem of public psychology, lethargy, resistance, and needs for far-reaching re-education—including that of our nation's teachers from elementary-school levels up. It is easy to say that the Government must pay the stupendous costs by one device or another, such as via tax relief, but this of course is visionary, since the public money must ultimately come from the people.

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COMMISSION 4

The Influence of Packaging on Freezing Time and Weight Loss for Cut Meat.

By G. LORENTZEN and S. RÖSVIK,
The Technical University of Norway, Trondheim (Norway)

INTRODUCTION

In a report to the Copenhagen congress in 1959 we presented some results of an investigation of freezing time for meat quarters at different conditions of air velocity and temperature. The variation of weight loss with the same parameters was also shown. It was found that direct freezing of warm meat, as soon as possible after slaughtering, gave important advantages over the conventional procedure of precooling before freezing. Very little difference in quality could be detected, although the direct freezing gave slightly better results in some respects. The present report concerns a continuation of this work. The purpose is to give practical data of freezing time and weight loss for cut meat and offals in different type and size of packages, as used in Scandinavian abattoirs. In the same way as in the previous investigations two parallel series of measurements were run, one with direct freezing of warm cut meat, the other with conventional cooling of the carcasses towards 0° C. and subsequent cutting and freezing.

The Biological Effects of the Conditions Produced in Sealed Plastics Containers by Prepackaged Fresh Fruits and Vegetables.

By R. G. TOMKINS,
Ditton Laboratory, Agricultural Research Council (Great Britain)

There has been a steady increase in the sale of prepackaged fruits and vegetables in Great Britain during the past few years and it can be assumed that this form of marketing is now firmly established. It is by no means clear to what extent the nature of the package affects quality or liability to wastage. Prepackaging may result in fruits and vegetables being subjected to conditions of higher humidity, higher concentra-

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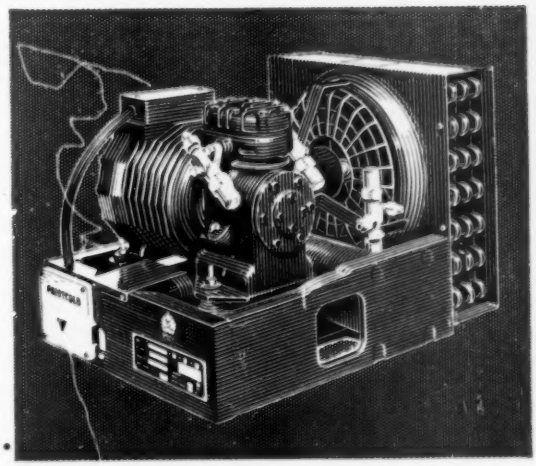

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tions of carbon dioxide and ethylene and lower concentrations of oxygen than those experienced in the handling of unpackaged produce. These conditions can affect the type and extent of wastage. The purpose of this paper is to consider (*a*) the factors determining concentrations of O_2 and of CO_2 found within sealed packages and to assess the likelihood of the occurrence of conditions which could cause damage, (*b*) the effect of high humidity within the package on microbiological spoilage and (*c*) the use of refrigeration in prolonging shelf life.

CONCLUSIONS

(1) Prepackaging in plastic containers can lead to conditions which can damage fruits and vegetables ; (2) Imperfections in material and in sealing rather than the permeability of the intact film probably determine the final concentration of CO_2 found in a package ; (3) The " leakiness " of plastic containers can be adjusted to allow a moderate and not excess build-up of CO_2 by the judicious spacing of pin holes ; (4) Liability to spoilage by fungal bacterial rotting is likely to be somewhat greater when fruits and vegetables are packed in film packages rather than in open containers ; (5) The most certain way of prolonging shelf life is by the fuller use of refrigeration.

Some Factors Affecting the Loss of Quality of Frozen Fish in Distribution.

By D. L. NICOL and R. SPENCER,
Humber Laboratory, Hull, Department of Scientific and Industrial Research, (Great Britain)

In 1958, over 10 per cent. of the British landing of white fish was frozen, producing over 40,000 tons, a considerable proportion of which was sold in Britain as consumer packs through retail cabinets, nominally maintaining 0° F. (-18° C.). Such sales have been increasing yearly for some time and can be expected to continue increasing. Although the British fish freezing industry in general endeavours to freeze only good quality, fresh fish, a preliminary survey of the products on sale and of the conditions obtaining during distribution indicated that the eating quality of the article when purchased could probably be improved. As loss of quality after freezing depends largely on the temperature history of the fish during distribution and retailing, further temperature measurements have been made on frozen fish under commercial conditions including the retail stage.

It is concluded that in the United Kingdom the eating quality of a significant proportion of consumer packs of frozen fish would probably be upgraded if improvements were made in the temperature control during distribution, particularly during handling and frozen food cabinets. Without cold store depots insulated vehicles awaiting further unpredictable technological advances it would seem that better instruction of everyone handling frozen fish could effect an immediate improvement in quality.

Effect of Subfreezing on the Quality and Storage Life of Fish.

By N. A. GOLOVKIN,
Leningrad Technological Institute of the Refrigerating Industry ;
L. I. PERSHINA,
Scientific Research Institute for Mechanization of the Fishery Industry, Leningrad (U.S.S.R.)

Up to the present, subfreezing (partial freezing) during the chill storage of products has been regarded as an objectional feature. However, this did not check investigators who, with a view to the possible prolongation of storage life, repeatedly turned to this method of treatment and storage. In recent years, attempts were made in the U.S.S.R. to apply subfreezing on an industrial scale as a method of refrigerated treatment of fish. In addition to prolongation of storage life, subfreezing should allow iceless transport of fish, thereby considerably increasing the freight capacity of refrigerated transport. The unloading and grading of the subfrozen fish at the refrigerated distributing warehouse should prove to be labour saving as compared to iced fish handling. Continuous subfreezing or batch subfreezing with very slight stops in the operating cycle provide conditions for considerable increase in output capacity of the technological equipment, a factor which is of particular importance in the periods of peak supply of the fish. The merit of subfreezing in prolonging the storage life of fish has been indicated in standard works of Soviet scientists. Summarizing one may state that a certain degree of crystallization of the water in fish tissues in general has a favourable effect on the prolonged preservation of its originally high quality. Although biochemical processes take place quite rapidly in the initial period due to increased salt concentration, subsequently the temperature factor begins to play a major role, slowing down the development of enzymatic changes.

What Values Accrue from Prepackaging Fresh Produce ?

By R. E. HARDENBURG,
U.S. Dept. of Agriculture, Beltsville, Md. (U.S.A.)

Produce prepackaging continues to expand in the United States. Estimates by Donald Stokes of the U.S. Department of Agriculture indicate that about 30 per cent. of the fresh fruits and vegetables in the United States are now marketed in consumer packages. The percentage was only 20 per cent. in 1955. There is still much room for growth of prepackaging even though some kinds of produce probably will never be packaged. Growth of prepackaging has followed the development of the self-service supermarket. Supermarkets represent only 10 per cent. of the food stores in the U.S.A. but they sell 68 per cent. of the food. With supermarket merchandizing dependent on self service, prepackaging is an effective method of utilizing loose produce for display. Packaging of other products, such as eggs, sugar, and soap, is standard procedure. Prepackaging has not produced all the advantages sometimes claimed. However, it has created great interest in improved handling and quality maintenance. Expansion in use of precooling, refrigerated transit, and refrigerated cases for retail display are particularly encouraging.

Vacuum-packed, Frozen Fatty Fish.

By F. BRAMSNAES and
H. C. SØRENSEN,
Fisheries Technological Laboratory, Copenhagen (Denmark)

A major difficulty in the storage of frozen fatty fish like herring, mackerel, salmon and trout is the development of rancidity due to the high content of unsaturated fats in the flesh of these fishes. This rancidity has been an obstacle in the sale of pre-packaged, frozen fatty fish. An effective and simple method of controlling rancidity in frozen fatty fish is storage at low temperatures (Banks, 1937). When the fish are stored for more than about three to four months, temperatures in the vicinity of -18° C. (0° F.), *i.e.* the most commonly used temperature in commercial cold stores, are not low enough. Consequently there is a general trend now in all countries to use temperatures of about -25° C. (-13° F.) in fish cold stores. However, in many cold stores these low temperatures desired for fish products are not available and this is also often the case during shipment, loading and unloading and during retail distribution of frozen fish. There is an interest, therefore, in methods of handling and processing, which may give frozen fish an additional protection against rancidity. Treatment with antioxidants and improved packaging in order to minimize contact with air are among such methods.

Vacuum packing considerably delayed the development of rancidity. No significant differences were observed in this respect among the three types of foils used for vacuum packing, namely the laminates : Cellophane/polyethylene, Cellophane / Saran / polyethylene, and Mylar/polyethylene in spite of the fact that these foils vary somewhat in regard to penetration of oxygen. The reason may be that the differences are too small to be significant in the period of storage chosen in the experiment.

COMMISSIONS 4 *and* 5
(Joint Session)
Treatment of Cut Flowers and Bulbs

By R. ULRICH,
Laboratoire de Bellevue, Meudon-Bellevue (France)

The successful storage of cut flowers depends on the condition of the formation of the flower in the field (soil, climate) and on the conditions of picking (hour, stage of development). They must be stored under refrigeration at

more or less low temperature, according to species, in very humid atmosphere, preferably without supply of liquid water. The use of more or less waterproof containers or packagings results in a change in the composition of the atmosphere which can be favourable within certain limits. At the end of the storage time, a large supply of water at low temperature can be useful. The survival at home at the ordinary temperature can be increased by addition of water of various materials to water. The main storage accidents are listed. The cold treatment of bulbs, tubers, cormus and rhizomes is studied from the example of tulip to define the main biological effects of refrigeration : stopping dormancy indispensable for the preparation of flowering and consequently capable to be used in forcing, slackening the growth of flowers capable to be used to delay flowering or to permit of long distance transport. Various examples are quoted and the main storage accidents mentioned.

COMMISSION 5

Air Curtains for Use on Cold Stores

By W. R. MICHAEL,
Minikay Ltd., London

The air in a cold chamber at -20° C. is 18 per cent. denser than external air at +20° C. This means that the pressure exerted by the column of cold air in a chamber 2·5 metres high is greater than that of a column of outside air of the same height by 0·53 kg. per m. With the door closed this usually shows as excess pressure on the floor of the store. When the door is open this pressure difference is experienced partly by an excess of pressure on the floor of the chamber and partly by the lowering of the pressure at the top of the chamber as compared with external air of the same height. These combined pressures cause an air flow into the store at the lintel of 2·0 m/s and outwards at the floor also of 2·0 m/s. Taking an average size door, this results in an air interchange of 2 m^3/s sufficient to empty a chamber of 2·5 m. by 6 m. by 15 m. in two minutes. Owing to the effect of turbulence at the half height of the door and to mixing inside the store, the actual rate of air change would be about half this. Each change of air entails the loss of 4,400 Kcal., which is the same amount as would pass through the walls of average conductivity in three hours, and the ingress of 2·7 kg. water vapour. This demonstrates most clearly that every effort must be taken to reduce the air passage through the doorways. From what has been said from the pressure existing between a normally cold store and ambient, it will be readily appreciated that an air curtain cannot work satisfactorily on a chamber with an opening to another space at either higher or lower level. If this limitation is ignored whenever the access doors in both spaces are open, air will enter over the whole area of the upper door and will emerge over the whole area of the lower door. The simple form of air curtain described in this paper cannot be adjusted to correct this. Provided that an air curtain has been correctly installed and adjusted at a site that is inherently suitable for its use, it gives a cold store operator uninterrupted passage into and out of the chamber and at the same time enables the chamber to be kept acceptably close to its normal operating temperature. The necessary equipment is mounted over the doorway where it is not likely to be damaged, and the only moving part requiring maintenance is a fractional h.p. motor. It is therefore a very successful and reliable piece of equipment for cold stores.

Mechanically Operated, Sliding, Insulated Door with Positive Seal.

By F. HARBORD,
Autozero Limited, Dublin (Eire)

The post-war development in handling by fork truck and pallet has led to a need for larger doors to refrigeration chambers compared to those of pre-war times. In planning a new one-floor cold store in Dublin, Ireland, my company were faced with the problem of designing a hinged door 9 ft. 6 in. by 6 ft. wide. It was decided in 1955 to experiment with a radically altered door. This took the form of a travelling, horizontal, sliding design and as this patented door may be of interest to those having similar plants or plans this illustrated paper was offered to this congress. The sliding door has become almost a necessity due to the modern trend to palletize, which means considerably larger doors to admit the load and fork truck—and more so, if ton loads are stacked to 16 or 20 ft. high. Under such conditions openings of approximately 9 ft. 6 in. high by 6 ft. wide have proved satisfactory. It may interest you to note that a door of only 5 ft. width does not give sufficient working clearance for pallets of from 40 in. to 42 in. wide, invariably the truck operators damage the door frame, whereas we have now been operating for the past four years without any damage. The sliding door eliminates not only a loss of floor space but saves the continuous maintenance of such a heavy swinging door, and lends itself admirably to fully automatic control, thus saving in man-power and time. Remote control can be situated at any convenient position to synchronize with the speed of the truck load to the speed of the door travel, allowing the operator immediate entry to the store or cold chamber without stopping the vehicle. Closing the door can be effected by similar remote control in the store. Since fitting these sliding doors practical experience has shown that we can now transfer from the store to the loading bag, or vice versa, 25 tons per hour with one man operating the reach truck and one operating the pallet truck with little or no increase in room temperature. There is also a psychological gain, the operator or storeman now closes the door automatically, whereas in the past this operation was done with reluctance.

Quality Deterioration and Bacterial Growth in Prepacked Bacon.

By NIELS-HENRIK HANSEN
Danish Meat Research Institute, Roskilde, Denmark

In the microbiological control of sliced vacuum-packed bacon, it has often been observed that no simple relationship exists between the bacterial counts and the organoleptic quality. Bacterial counts of the order of magnitude 10^7 and 10^9 per gramme are often found at a point of the storage where the product shows no signs of spoilage. Often spoilage occurs many days after the maximum obtainable bacterial counts are reached. This meant that bacterial counts could not be used as an indicator of the freshness of the product. In this investigation an attempt was made to study the relationship between bacterial growth and organoleptic quality at three different storage temperatures. The results indicate that the deterioration of taste of the cooked bacon depends on the "bacterial activity," *i.e.* the area between the bacterial growth curve and the base line. The smell of the bacon seems to deteriorate mainly according to the same principle as taste. However, the taste of the bacon deteriorates more rapidly than the smell. The impression of saltiness seems to increase during storage at the same extent as the taste deteriorates. For bacon which has been frozen the impression of saltiness was generally more pronounced than bacon which has not been frozen. The appearance of the bacon seems to deteriorate very slowly during storage and independently of the storage temperature.

Plan for the Testing and Development of the Jacketed Room System.

By C. P. LENTZ,
National Research Laboratories, Ontario (Canada)

The most important advantages of the jacketed, or envelope (double wall) system for cold room construction compared with conventional construction (direct cooling) are the maintenance of almost ideal conditions for the storage of frozen foods and the minimization of deterioration of insulation due to moisture condensation. Recent work indicates that the jacket system may be even more important in the storage of fresh fruits and vegetables than frozen foods. A survey should be made of all known commercial jacketed storages with the following information being collected : Design information, operating data, product data. Reliable design information based on tests and experience, where possible, should be compiled on the following aspects of jacketed storage construction (authorities who have had some experience might be asked to contribute on the various topics in this section) : Storages of different shapes and sizes, partial jacketing and cost estimates.

TRAPPED RADICALS AT LOW TEMPERATURES

THE Fourth International Symposium on Free Radical Stabilization, arranged and co-ordinated by the U.S. National Bureau of Standards, was held in Washington District of Columbia, U.S.A. More than 325 scientists attended the meetings, which emphasized fundamental research results obtained in studies of the highly reactive molecular fragments. In line with the theme of the meeting, "Trapped Radicals at Low Temperatures," papers were concerned with the properties of solids containing trapped radicals and the chemical and physical interactions involving trapped radicals at low temperatures.

This series of annual symposia has grown naturally out of the widespread interest in the trapping of free radicals, which reached a high around 1955. At this time, it became possible to trap the radicals in quantities large enough to study. Ordinarily, radicals exist for only a few thousandths of a second, in systems such as flames and hot gases. However, by freezing the products of an electric discharge

L. Vegard, one of the first scientists to study frozen free radicals over 30 years ago, examined an exhibit at the Fourth International Symposium on Free Radical Stabilization. The symposium, held in Washington, was sponsored by the U.S. National Bureau of Standards.

at a few degrees above absolute zero, it is possible to trap free radicals in a highly excited state, in which they can be kept for hours and studied by a number of physical and chemical techniques. Other methods for capturing and storing them include irradiation of material with gamma-rays, X-rays, or ultra-violet light, and bombardment with accelerated particles, such as electrons or protons.

This same intensified interest led the U.S. Department of Defence, in 1956, to sponsor a three-year Free Radicals Research Programme at the Bureau and the recent meeting gave interested scientists and research workers a last opportunity to view existing facilities and activities. Meetings were held at Dunbarton College, within walking distance of the bureau ground. A. M. Bass, Chief of the Bureau's Free Radical Section, was symposium chairman.

The symposium consisted of five sessions in which 29 papers and five short contributions were presented. The sessions were devoted to : The U.S. National Bureau of Standards Free Radicals Research Programme, Low Temperature Chemistry, Methods of Production of Trapped Radicals and Physical Properties of Radical-Trapping Solids, Identity and Concentrations of Trapped Radicals, and Future Trends in Trapped Radical Research.

Discussion of bureau work was essentially limited to the first session, in which the experimental and theoretical aspects of the Free Radicals Research Programme were covered by Bureau staff members M. D. Scheer and C. M. Herzfeld, respectively. Four other survey papers summarized the four sessions. These four papers also emphasized bureau work, but were broader in scope and attempted to define the state of accomplishment in a number of areas. They were presented, respectively, by R. Klein, guest worker at the Bureau from Olin-Mathieson ; A. Thomas, guest worker from Shell Research Ltd. ; R. Zwanzig of the bureau ; and O. Schnepp of the bureau, on leave from the Israel Institute of Technology.

One of the conclusions drawn from the conference is that emphasis is shifting from the radicals themselves to their use as a research tool. An illustration of this is the pioneering work of Klein and Scheer on the addition of H-atoms to solid olefins. This discussion, included in Dr. Klein's survey paper, pointed up the increasing importance of low temperature chemistry and the part that radicals will play. Another presentation of importance in this same general area was a paper by J. M. Flournoy, L. H. Baum, S. Siegel, and S. Skolnik of the Aerojet-General. Their kinetic studies of the disappearance of hydroxyl radicals in ice at 77° K. showed that the rate determining processes were diffusion or migration of the radicals through the ice.

The session on the Production of Trapped Radicals and the Properties of Radical-trapping Solids brought out the importance of the physical properties of the matrix. At present, the mechanism of deposition and condensation of gas on a surface at liquid helium temperatures is very poorly understood. The problem was pointed up by R. T. Brackmann and W. L. Fite, of General Atomic, who reported that in experiments with a hydrogen atomic beam they found no evidence of trapped species at liquid helium

Now available

A new one-hand stapling clincher, the "International," is now available. This machine is slimly designed to operate in restricted areas and also to staple cartons of unusual shapes. Its simplified lever and spring return action, makes staple driving both quick and positive. The hand lever operates a two-piece retractable anvil which penetrates the carton flaps. The driving blades push the staple downwards to a controlled depth. They then close inwards clinching the staple legs into a firm grip, without disturbing the contents of the carton. The unit comprises four major assemblies, which can be taken apart in five minutes with an ordinary screwdriver. The anvils can be changed in two minutes. Its simplicity of design demands the minimum of service. Whatever thickness of corrugation, the clincher can be adjusted to the required depth of staple penetration, from a blind clinch to a full clinch. Loading or unloading of staples is easy. Full details are obtainable from **Benrose Stapling Ltd.**, 28, Denbigh Street, London, S.W.1.

temperatures even when spin-aligned atoms were used. However, using molecular hydrogen at flow rates of the order of 10^{18} particles per second, they observed periodic energy releases occurring every few seconds during deposition. M. Windsor, guest worker at the bureau from the Space Technology Laboratories, suggested that these results might be caused by the presence of water vapour impurities, and described similar pulsing observations with discharged gases. He pointed out that the very presence of trapped atoms and free radicals in a matrix and the disorder thereby introduced are likely to reduce the thermal conductivity by several orders of magnitude. It is thus possible for large temperature gradients to exist between the cold substrate and the growing surface of the deposit. An interesting attempt to trap organic free radicals in an ionic crystal matrix of potassium chloride was described by H. T. J. Chilton and G. Porter of Sheffield University. However, their results appear to show that the trapping takes place in micro-crystals of the solute rather than in the matrix itself.

SPIN RESONANCE

Several papers on spin resonance were presented in the session on Identity and Concentration of Trapped Radicals. G. Pimentel of the University of California and R. Livingstone of the Oak Ridge National Laboratory agreed that the sensitivity of this method requires that gross chemical analysis be performed on electron spin resonance specimens to confirm the assignments of spectra. It was also brought out in discussion that, since the interpretations of polycrystalline spectra are ambiguous, more work be done with single crystals, on the order of that reported by C. A. McDowell and A. Horsfield of the University of British Columbia. H. Bent from the University of Minnesota described new oxides of nitrogen which, like free radicals, can be trapped at low temperatures in a thermodynamically unstable form. In his review, Dr. Zwanzig said that heat release and electron spin resonance measurements both lead to figures of a few tenths of a per cent. for maximum stable concentrations of free radicals.

Another important area is that of interaction of free radicals with solids, which was the subject for the last session. By using trapped radicals as a tool, and observing the effect of molecular environment on their molecular energy levels—as reflected by changes in optical spectra and electron spin resonance spectra—it is possible to get information about the structure of the matrix in the immediate vicinity of the trapped radicals. S. N. Foner of the Johns Hopkins University Applied Physics Laboratory found evidence for multiple trapping sites for hydrogen atoms in various matrices of rare gases at 4° K. M. McCarty and G. W. Robinson of Johns Hopkins University used a Lennard-Jones potential to account for the interaction between rare gas matrices and small radicals, observed by means of their optical spectra. The subject of the nitrogen-atom afterglow also came in for much discussion. R. A. Hemstreet and J. R. Hamilton from the Linde Company described kinetic observations of the isothermal decay of the alpha bands. They found it possible to restimulate the glow by raising the temperature of the sample from 4° in steps up to 30° K. As the glow dies off at approximately the same rate at each temperature, it is apparent that atoms are trapped in sites varying over a range of energy. Although the observed emission spectra can be correlated well with the emission from excited nitrogen atoms, the mechanism by which these excited atoms are formed is still not understood.

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All survey papers will be published in a monograph. For further information write A. M. Bass, Free Radicals Section, National Bureau of Standards, Washington, 25, D.C.

The Future of Ultra High Vacuum Techniques for Industrial Applications

By Mr. T. E. DAYS

Sales Manager, Leybold-Elliott Ltd.*

EVERYONE present will be familiar with the classical application of vacuum techniques, such as lamp and radio valve manufacture and laboratory work. In the last 15 years emphasis has been placed on vacuum for process work, and much work has been done to develop economic plant, *e.g.* vacuum coating for lens blooming has led to processes ranging from mass production of artificial jewellery to preparation of thin films for transistors.

The reciprocating vacuum pumps used in the chemical industry are now replaced by gas ballast pumps and roots pumps, and complete plants are available for distillation and molecular distillation.

The need for blood plasma for medical purposes initiated the development of freeze-drying units, which nowadays are applied to food processing on a large scale with throughputs of several tons per day.

With the increasing availability of electrical power, the study of impregnation processes has been intensified and an enormous improvement in the quality and reliability of capacitors, transformers and high voltage cables has resulted. Impregnation alone, however, is of small use without adequate drying and degassing of the components and of the impregnating material.

In all of these fields of work a general trend towards lower process pressures exists, and already for nuclear and semiconductor work ultra high vacuum is essential.

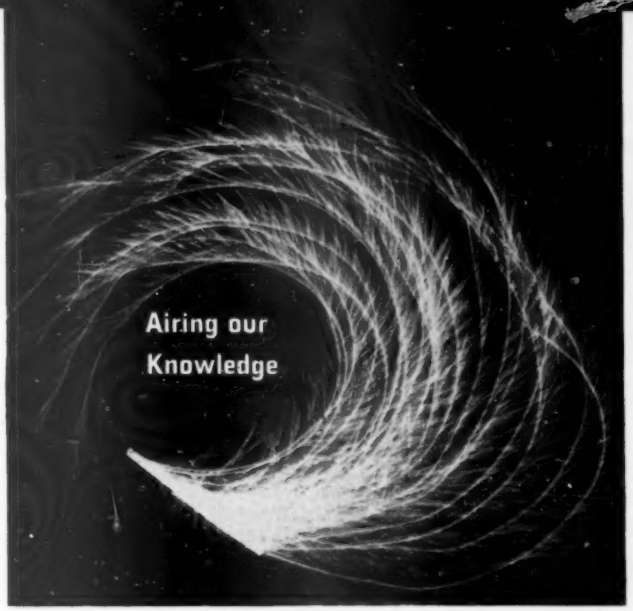
We have already mentioned the applications of coarse, medium high and high vacuum, and now we come to the applications in the ultra high vacuum region.

The particle density in the ultra high vacuum range is less than 108 particles per c.cm. At this density the mean free path is a considerable length in the order of kilometres, as opposed to the centimetre length for high vacuum. The time for contamination by gas molecules of a perfectly clean surface at a pressure of 10^{-6} mm. Hg. is of the order of one second, whilst at a pressure of 10^{-10} mm. Hg. this runs into several hours. This gives time for practical experimentation.

On pumping down a volume from atmospheric pressure, the first viscous flow of gases changes to molecular flow on attaining pressures in the range of 10^{-3} mm. Hg., steadily assuming a statistic character as the pressure decreases. In the ultra high vacuum range nearly 100 per cent. of gas removed from the system emanates from the internal surfaces of the vessel, provided that the system is reasonably leak-free and that suitable precautions have been taken to prevent backstreaming of diffusion pump fluid into the vessel.

In order to obtain pressures of less than 10^{-7} mm. Hg., it is necessary to start off with a vessel having very clean conditions.

* An address at Leybold-Elliott's open day.



1/670

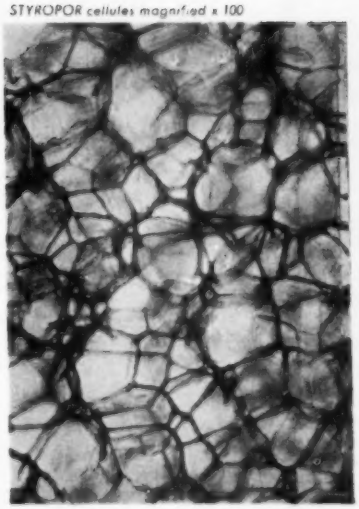
Every schoolboy knows . . . that a thin layer of down gives more warmth than a whole mountain of compressed feathers. The technician expresses it in a different way: Still air is the best insulator.

Talking about still air, let us take a look at BASF's ®STYROPOR. When it expands it forms a novel cellular plastics material containing up to 98% air. Millions of tiny cells hold this air entrapped – this is the secret of the foam's outstanding insulating properties.

Apart from this, the material has further important advantages: it is feather light (density as low as 1.25 lb/cu ft), has a very low water absorption (doesn't ice up when used as heat insulation), good mechanical strength, is resistant to sea water, and is easily processed to mouldings of any desired shape.

STYROPOR foam is used for insulating cold storage rooms in breweries, milk centres, abbatoirs, cold stores, refrigerator vans, air conditioning plant, roofs, and chilling apparatus and pipes for carrying chilled liquids.

STYROPOR cellules magnified x 100



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Metal vessels are given a shiny polished surface in the pre-treatment stage of manufacture to assist in subsequent cleaning. Once the vessel has been brought into vacuum conditions, it is necessary to bake out, and consideration must be given during the design to the relationship between vacuum tightness and the conditions existing during baking out. Synthetic rubber seals are usually suitable for baking out at temperatures of up to 100° C. Viton seals are now used up to temperatures of 200° C., and for baking out at higher temperatures metal seals must be used. (The influence of different baking out temperatures on the decrease of pressure as a function of pumping down time and on the ultimate vacuum was illustrated by the speaker.) A large quantity of gas is liberated from the metal surface when the temperature rises to 100° C. and to 360° C. The rise of pressure is determined only by the film of water on the walls at a temperature of above 360° C. In order to increase these effects and give an even greater reduction of outgassing from the walls of a vessel after baking, it can be cooled down very considerably freezing out the mobile gas molecules (principle of the Cryo pump).

An oil diffusion pump filled with a pump fluid having a vapour pressure of about 10^{-8} mm. Hg. at 20° C. is very suitable for processes in the ultra high vacuum range. Using only a water-cooled baffle above the diffusion pump, the ultimate pressure obtained will be in the high vacuum range, this corresponding to the saturated vapour pressure of the oil molecules that condense on the baffle. When a second baffle, of a refrigerated type operating at around –40° C., is mounted above the water-cooled baffle, the vapour pressure of the pump fluid in the chamber will be considerably reduced and pressures of 10^{-9} mm. Hg. and better will readily be attained, the major influences then being the sealing material, the baking out temperatures and the duration of the baking out period. In place of the refrigerated baffle it is possible to use a cold trap filled with liquid air. The prevailing temperatures of –180° C. will reduce the pressure to an even lower point, and pressures of the order of 10^{-9} mm. Hg. and better will then be attainable.

In addition to the main diffusion pump with water-cooled baffle and refrigerated baffle, there is a small diffusion pump with a separate baffling system. This is the assembly used by Leybold in their laboratories for measuring the pumping speed of oil diffusion pumps down to the pressure of 10^{-10} mm. Hg. shows the result of such an experiment.

For experimental work, constructional components intended for high vacuum have been used in ultra high vacuum conditions. Now, however, ranges of standard type series manufactured parts are available which have been designed to ultra high vacuum standards permitting baking up to temperatures of 400° C. and having a guaranteed total leakage rate of less than 5 by 10^{-9} lusecs, then built up into a constructional unit. With components of this type a packaged pump system can be assembled. This pump set has a glandless high vacuum valve with very low throttling, giving only a 50 per cent. loss in pumping speed. The vessel in an ultra high vacuum pump system can also be made with a double-walled construction. Even though this construction is complicated having two pump sets and being relatively expensive, it has considerable advantages in that it provides a possibility of being able to bake out in an ideal manner the inner metal vessel containing the ultra high vacuum space, is not subject to any pressure, and can therefore be made of a very thin material. This gives the possibility for direct electric current heating using the wall as the heating element. The low pressures in an ultra high vacuum system must be measured with an ionization gauge. Here the electrode structure is based on the Alpert gauge consisting of a tungsten cathode located outside a cylindrical spiral anode and having a single-wire ion collector which is sited axially and centrally within the spiral anode. This construction avoids the production of secondary electrons in measurable quantities at pressures down to 10^{-10} mm. Hg., a defect existing in the conventional type ionization gauge where electrons are caused by the well-known X-ray effect. This possibility of an incorrect pressure reading is therefore eliminated.

The materials used for the electrode construction are selected to give the minimum outgassing during operation in order to have the least possible effect on the measurements.

Various methods are available for determining the composition of the residual gas in a system. The Farvitron is a partial pressure indicator enabling masses to be identified simultaneously in the range extending from mass 2 to mass 250. The instrument will indicate the presence of masses that have a content of more than 3 per cent. of the residual gas in the high vacuum or ultra high vacuum system. The spectrum of the residual gases is plotted continuously on the screen of an oscillograph. This is scanned with a frequency of 50 c/s and quite rapid changes in the composition of the gas can be easily and clearly followed. The heights of the individual peaks on the oscillograph screen permit only a quantitative analysis to be made, but cannot be used for any quantitative measurement.

A second method of measurement is possibly using the omegatron. Its resolving power permits individual gases to be identified up to mass 28 and enables masses to be measured in the range extending to mass 150. In its working principle the omegatron is a small cyclotron. The electrode system in the tube illustrated is made of platinum in order that it could be baked out efficiently and used in the range of ultra high vacuum without introducing errors from outgassing.

Among the exhibits we have here you will see a Farvitron representing one of the latest technological advances in industrial high vacuum. You will also see diffusion pumps of very modern construction suitable for use at ultra high vacuum pressures.

In order to give an impression of the extent of the installations for perlon drying, cable impregnation, monoglyceride distillation and continuous freeze-drying, Mr. Days presented scaled models.

CZECHOSLOVAKIAN CHEMICAL INDUSTRY

(continued from page 1275)

employing limit controls 402 and 404. This pressure limit control maintains pressure behind regulation dampers in the lines of the 1st and 2nd stages at a value lower than the adjusted one, by controlling slide valves 501 and 502. By this is ensured that pressure in suction line of the 1st stage of compressor does not rise above 1, 9 to 2,0 ata at which value the machine would become overloaded.

All these control units work automatically, with the provision for switching to hand control.

Each machine has its own control panel with instruments for operational control and protection.

Apart from operational signalling system of the principal parameters, each machine is provided with an alarm signalling system giving warnings of abnormal values of the most important parameters. In case one of the working parameters reaches emergency limits the machine is cut off automatically. The machine can be started again only after having fulfilled the blocking conditions, *i.e.* after creating conditions for restarting (refrigerant and oil pressure, voltage, etc.).

The plant is provided with a set of direct- and remote-control instruments.

Conclusion

According to the present development of requirements put on centrifugal refrigeration systems in Europe it may be expected that in European conditions, which greatly differ from those in the U.S.A. there is going to be a growing demand for centrifugal refrigerating systems, especially in the chemical industry producing basic chemicals for plastic and synthetic materials.

As a consequence it may be presumed that the future development of centrifugal refrigerating systems in Europe will be determined by technical solving of problems relating to centrifugal refrigerating systems for the chemical industry, as put forward in present paper.

America Prepares Greatest Exhibition of Air-Conditioning History

IMPRESSIVE COLLECTION FOR WASHINGTON

THE Smithsonian Institution, Washington, D.C., America's national museum, is planning to arrange and install into the museum building, a permanent refrigeration exhibition, second to none all over the world. It will be opened in 1962.

The Institution has just received a highly interesting item for the coming exhibition. It is *the first centrifugal air-conditioning compressor*, the foundation-stone of the modern air-conditioning industry, a donation from the Carrier Corporation of Syracuse, New York State.

The practical centrifugal refrigeration compressor was one of a series of contributions made by Dr. Willis Carrier, just at the beginning of the 20th century, to the development of scientific air-conditioning.

Attempts to control room temperatures through various devices were not new when Dr. Carrier began to work on the problem in 1902. Leonardo da Vinci, Benjamin Franklin and Alexander Graham Bell had experimented with ice, evaporation and other means. These efforts were aimed simply at greater physical comfort. Dr. Carrier, just 25 and a year out of college, went beyond anything attempted up to that time. He was one of the principal members of the research department of the Buffalo Forge Co., a heating concern.

A client of Buffalo Forge, the Sackett-Wilhelms Lithographing & Publishing Co., of Brooklyn, had a humidity problem connected with the publishing of *Judge*, the once-popular humorous magazine, and other magazines. Atmospheric conditions caused paper to expand or contract as the humidity varied. This showed up in faulty printing and annoyed the printers a good deal in the hot, humid summers of 1900 and 1902. First Dr. Carrier tried a process which took the moisture out of the air. He used a roller-towel arrangement with loosely woven burlap which was kept flooded with a brine solution. Air was drawn through the burlap by a fan, but everything else about the test operated manually ; a man dipped brine from a barrel and poured it over the cloth and a man turned the rollers. In about a week the first test was abandoned. The calcium chloride brine took the moisture out of the air but left a salt residue which caused the machinery to rust.

The young engineer then converted an apparatus used to test heaters ; but in place of steam he circulated cold water through its coils. His process performed the four basic functions of air conditioning : 1, control of temperature ; 2, control of humidity ; 3, control of air circulation and ventilation ; and 4, cleaning of air.

With a practical air-conditioning system available, Dr. Carrier became concerned with the need of a more compact refrigeration system than could be had using a reciprocating compressor, and of the necessity of a completely safe, non-toxic refrigerant in place of the commonly used ammonia. In 1922 he built the first effective refrigeration machine using a centrifugal compressor and a safe refrigerant.

The function of the refrigeration machine in an air-conditioning system is to provide chilled water—generally between 45° and 55°—which flows through coils, over which the air passes. Prior to development of the centrifugal system, the basis of most refrigerating machinery was a large, slow-speed reciprocating compressor which compressed the refrigerant into a liquid state by the action of pistons in cylinders. Dr. Carrier's new machine, far smaller for an equivalent capacity, substituted the action of centrifugal force, applied by rotors spinning at high speed inside restricted chambers.

This development soon carried air-conditioning beyond its limited early applications in the printing, textile, food processing and other industries where temperature and humidity control were necessary in the production process itself. Air-conditioning began to expand into the field of " comfort cooling " and was installed more and more in theatres, department stores, hotels, office buildings and residences—in fact, into almost every type of building.

Dr. Carrier put his first centrifugal machine in the Carrier offices at Newark, N.J., for test purposes. It was then sold to the Onondaga Pottery Co. in Syracuse, N.Y. It operated there until a few years ago, when it was placed on standby duty. Later it was repurchased by Carrier for presentation to the Smithsonian Institution.

By Our Legal Correspondent

Payment of Wages Act 1960

Under the 1960 Act, under certain conditions wages may be paid other than by cash. It is essential, however, that the wage-earner should make a request in writing to his employer to that effect. The employer is not required to reply in writing. He may signify the agreement either by writing back or simply by paying the wages in the way specified by the employee's request.

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New Companies

The accompanying particulars of New Companies recently registered are taken from the Daily Register compiled by Messrs. Jordan and Sons Ltd.

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Thermaseal Ltd., South Bank Chambers, South Brook Terrace, Morley Street, Bradford. Secretary: Edith Hall. To carry on the business of insulating specialists, etc. Nominal capital: £100. Directors: Clarence Hall, 12 Troydale Close, Pudsey, near Leeds; Mrs. Edith Hall, 12 Troydale Close, Pudsey, near Leeds.

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Coldharbour Refrigeration Co. Ltd., National Provincial Bank Chambers, Tooting Broadway, S.W.17. Secretary: Joan A. Collins. Nominal capital: £2,000. Directors: George A. Collins, 1a Grove Park Road, N.15; Leslie E. Slay, 12 Copthall Drive, N.W.10; Mrs. Joan A. Collins and John A. Millard.

Norska Refrigerators Ltd., Albion House, Queen Street, Oldham, Lancs. Nominal capital: £2,000. Directors: William H. Fernihough, 20 Wensley Road, Gatley, Cheshire; George Paul, "Hurstdene," South Downs Road, Bowdon, Cheshire.

America Prepares Greatest Exhibition of Air-Conditioning History

IMPRESSIVE COLLECTION FOR WASHINGTON

THE Smithsonian Institution, Washington, D.C., America's national museum, is planning to arrange and install into the museum building, a permanent refrigeration exhibition, second to none all over the world. It will be opened in 1962.

The Institution has just received a highly interesting item for the coming exhibition. It is *the first centrifugal air-conditioning compressor*, the foundation-stone of the modern air-conditioning industry, a donation from the Carrier Corporation of Syracuse, New York State.

The practical centrifugal refrigeration compressor was one of a series of contributions made by Dr. Willis Carrier, just at the beginning of the 20th century, to the development of scientific air-conditioning.

Attempts to control room temperatures through various devices were not new when Dr. Carrier began to work on the problem in 1902. Leonardo da Vinci, Benjamin Franklin and Alexander Graham Bell had experimented with ice, evaporation and other means. These efforts were aimed simply at greater physical comfort. Dr. Carrier, just 25 and a year out of college, went beyond anything attempted up to that time. He was one of the principal members of the research department of the Buffalo Forge Co., a heating concern.

A client of Buffalo Forge, the Sackett-Wilhelms Lithographing & Publishing Co., of Brooklyn, had a humidity problem connected with the publishing of *Judge*, the once-popular humorous magazine, and other magazines. Atmospheric conditions caused paper to expand or contract as the humidity varied. This showed up in faulty printing and annoyed the printers a good deal in the hot, humid summers of 1900 and 1902. First Dr. Carrier tried a process which took the moisture out of the air. He used a roller-towel arrangement with loosely woven burlap which was kept flooded with a brine solution. Air was drawn through the burlap by a fan, but everything else about the test operated manually ; a man dipped brine from a barrel and poured it over the cloth and a man turned the rollers. In about a week the first test was abandoned. The calcium chloride brine took the moisture out of the air but left a salt residue which caused the machinery to rust.

The young engineer then converted an apparatus used to test heaters ; but in place of steam he circulated cold water through its coils. His process performed the four basic functions of air conditioning ; 1, control of temperature ; 2, control of humidity ; 3, control of air circulation and ventilation ; and 4, cleaning of air.

With a practical air-conditioning system available, Dr. Carrier became concerned with the need of a more compact refrigeration system than could be had using a reciprocating compressor, and of the necessity of a completely safe, non-toxic refrigerant in place of the commonly used ammonia. In 1922 he built the first effective refrigeration machine using a centrifugal compressor and a safe refrigerant.

The function of the refrigeration machine in an air-conditioning system is to provide chilled water—generally between 45° and 55°—which flows through coils, over which the air passes. Prior to development of the centrifugal system, the basis of most refrigerating machinery was a large, slow-speed reciprocating compressor which compressed the refrigerant into a liquid state by the action of pistons in cylinders. Dr. Carrier's new machine, far smaller for an equivalent capacity, substituted the action of centrifugal force, applied by rotors spinning at high speed inside restricted chambers.

This development soon carried air-conditioning beyond its limited early applications in the printing, textile, food processing and other industries where temperature and humidity control were necessary in the production process itself. Air-conditioning began to expand into the field of " comfort cooling " and was installed more and more in theatres, department stores, hotels, office buildings and residences—in fact, into almost every type of building.

Dr. Carrier put his first centrifugal machine in the Carrier offices at Newark, N.J., for test purposes. It was then sold to the Onondaga Pottery Co. in Syracuse, N.Y. It operated there until a few years ago, when it was placed on standby duty. Later it was repurchased by Carrier for presentation to the Smithsonian Institution.

By Our Legal Correspondent

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COMMERCIAL NEWS

(*continued from page* 1266)

R. A. Bennett & Co., Pelsall, Staffs, announce acquisition of 4,000 sq. ft. premises at Brownhills. Conversion of these premises is now under way and includes a self-service type showroom of approximately 1,200 sq. ft. The building holds a prominent position at the corner of High Street and Lichfield Road, Brownhills—20 minutes from Birmingham via main Chester Road (A452). Coventry, Leicester, Nottingham, Derby, Stafford, Shrewsbury, all approach by A5 and A452 virtually free of speed restriction. Ample parking and loading facilities are included in the site. The big increase of stocking and handling facilities now made possible by the acquisition of these premises will greatly support the "next day delivery certain" within the limits of the area covered by Messrs. Collins express parcels service. When the new premises are fully operative new address and telephone number will be notified to all concerned.

* * *

The Amprobe Division of the **Pyramid Instrument Corp.,** announces the introduction of the new Amprobe model RS-3. This all-purpose instrument permits the measurement of current voltage and resistance. With a built-in recessed range selector the RS-5 provides for the selection of ranges varying from O-5 amperes to 250 ohms. British agents for the

Pyramid Instrument Corp., are H. J. Baldwin & Co. Ltd., 221 Grand Buildings, Trafalgar Square, London, W.C.2.

* * *

A new industrial service, the application of a comprehensive range of anti-corrosion and protective coatings to heavy equipment up to 5 tons in weight, under factory conditions, has been established in Manchester. The new service is based on specialised plant recently installed at Norton Street, Miles Platting, Manchester, by **West's-Loyne Ltd.,** a company jointly formed by W.G.I. Limited (West's group of industries) and Loyne Ltd., protective coating specialists, of Ashton-under-Lyne. The plant, which is adjacent to the main works of the West's group, includes one of the largest fully-automatic shot-blasting cabinets installed in Britain for this kind of work and a large gas-fired oven for the sintering and stoving of coatings, or the heat treatment of metals. The installation is complete with the most up-to-date preparation and coating equipment and the necessary cranes for the moving of large items while under treatment. The new company will operate in close collaboration with Loyne Limited, an organisation whose wide experience in the coating field includes the application of a wide range of coatings to all types of equipment at their factory at Ashton-under-Lyne and site work on large and heavy fabrications in all parts of the country. The service offered by West's-Loyne Limited, like that of Loyne Limited, includes technical advice in addition to surface preparation and application and curing of coatings. Among the coatings applied are :—Epoxy resins (for the lining of vessels containing food, oil or chemicals) ; phenolics (water and acid resistant) ; synthetic rubber (abrasion resistance and corrosion prevention) ; polytetrafluoroethylene (non-stick dispersion coatings for a variety of uses in industrial and domestic equipment) ; polytrifluorchlorethylene (insulation and resistant to high temperatures and corrosive gases and acids) ; silicones (non-stick, heat and chemical resistant) ; metal spraying (zinc, aluminium, stainless steel) ; and flame spraying (polythene, nylon, P.V.C.).

PRESTCOLD AT VIENNA FAIR

This elegant array from the Prestcold range of refrigerators attracted crowds of admiring visitors to the recent Vienna Fair. The stand was organised by Eichberger & Co., of Vienna—Prestcold's distributors for Austria. Their end-of-show comment: "This year's fair was a huge success. We met many new customers and particular interest was shown in our new automatic ice-cube maker." This model (extreme left of picture) can produce up to 1,600 ice cubes in a day with absolutely no effort on the part of the user.

BUYERS' GUIDE

WORLD'S FIRST QUICK-FREEZE LOBSTER BOAT

CALLED the *Francoise Christine*, the first quick-freeze lobster fishing boat in the world which carries out vacuum packing of lobster meat on board ship was launched at Camerat, France, recently.

The canning and packing process under vacuum in rilsan bags requires a thorough understanding of the equipment by the crew which could only be acquired by extensive training and guidance. One refrigeration and one packing expert were shipped out on the first trip to guide and advise the crew for two weeks. With the successful conclusion of this instruction trip, the results of the next trip, scheduled to last three months, will be quantitatively more productive and should reach approximately 25 tons.

Fishing for lobster is done with drag-nets and the catch is prepared and frozen on board the trawler. The lobster are cut into sections, packed in plastic bags under vacuum, quickly frozen and stored in the hold. Freezing takes place in two tunnels which are capable of quick-freezing, at a temperature of minus 45°F., three tons of fish per 25 hours. After leaving the freezing tunnels, the fish is put in cold storage at minus 9°F.

25 tons cold storage

Total cold storage capacity amounts to 25 tons of processed fish and total refrigeration capacity for the various operations to 100,000 large calories per hour.

There are currently in use two other processes for the conservation of lobster. The first of these consists in storing the lobster catch alive in salt water tanks on board, which can hold 70,000 to 80,000 lobsters. They are then sold alive on the markets at the high price of live lobsters.

The second process consists in fitting out boats for the quick-freezing operations only. These vessels accompany the fishing boats, but the method complicates handling of the catch and results in an appreciable loss of weight and poorer quality.

The *Francoise Christine* was designed to obviate these disadvantages and she is fitted out with installations for quick-freezing and packing of the catch during the trip. The advantages obtained are questions both of economy and quality.

Packing the lobster in plastic bags immediately after preparation and before quick-freezing seems to by a method which prevents a loss of weight of the order of eight per cent. In view of the market price of lobster and the large tonnages concerned, the quick-freezing method in conjunction with direct sale will permit an appreciable lowering of the price to the consumer.

A second advantage, and by no means the least, is the better condition of the merchandise in the retail store and the total elimination of the slightly "rubbery" taste of frozen lobster not immediately packed on the fishing boat. It is no exaggeration to say that the characteristics of lobster meat packed on board the *Francoise Christine* are identical with those of freshly caught lobsters.

Encouraged by the results of the new lobster trawler, the owners are fitting out a second such boat, the *Charleston*, which will be slightly longer (108 instead of 98 ft.) and have a larger storage capacity at the same temperature of minus 9°F. It is now in the process of being fitted and will take to the sea in a few months.

When both trawlers are in operation simultaneously, they will produce from their four annual trips about 200 to 250 tons of quick-frozen lobster meat which corresponds to about 500 tons of live lobsters. Both boats will ultimately be equipped also with crushers to process the lobster heads.

New Companies

The accompanying particulars of New Companies recently registered are taken from the Daily Register compiled by Messrs. Jordan and Sons Ltd.

North Wales Refrigeration Ltd., Lloyd Buildings, Llandudno. Secretary: Leonard Davies. Nominal capital: £100. Permanent directors: Idris Price, 1, Eaton Avenue, Old Colwyn; Thomas Roberts, 17, Ffordd Cwstenin, Mochdre, Colwyn Bay.

Refrigeration and Air Movement Co. Ltd., Refrigeration engineers, etc. Secretary: Thomas A. Herbert. To acquire lands, etc. Nominal capital: £100. Directors: to be appointed by subscribers. Subscribers: Jean Herbert (company director) and Thomas A. Herbert (barrister), 156, Strand, W.C.2.

Andrew Air Conditioning (International) Ltd., 57/9, Victoria Street, S.W.1. Secretary: E. R. Lewis. Nominal capital: £1,000. Directors: Sydney Holt, 4, Palace Court, Bayswater, W.2; Edward R. Lewis, 1, Lisburne Lane, Stockport; Dott. Ing. Emilo Mariani, Milan, Italy. Solicitors: Bell, Haugh & Co., Stockport.

Fridgemobile Ltd., 76, High Street, Bedford. Secretary: Shirley Hart. To carry on business of manufacturers of and dealers in refrigeration and other vans, lorries, etc. Nominal capital: £100. Directors: to be appointed by subscribers. Subscribers: Shirley Hart and Averil Hart, 57, Rodney Court, Maida Vale, W.9.

Kerr-Shaw (St. Annes) Ltd., 37, School Road, Sale. Secretary: B. Flinter. To carry on the business of distributors, installers and retailers of air-conditioning equipment, oil-fuel central-heating equipment, etc. Nominal capital: £100. Directors: Joseph Kershaw and Ida Kershaw, both of 450, Clifton Drive North, St. Annes on Sea; Barbara A. Payne and Bernard Flinter; Patricia A. Marriott, 10, Broad Hey, Romiley. Solicitors: Bernard Flinter & Co., Sale, Cheshire.

Payne & Mighall Ltd., 13, Ash Grove, Haywards Heath. To carry on business of plumbing and heating engineers, refrigeration engineers, etc. Nominal capital: £500. Directors: Eric A. Payne, 13, Ashgrove, Haywards Heath; Kenneth M. Mighall, 13, Fair Place, Wivelsfield Green, Sussex. Registered by solicitors: Ernest Randall & Rose, W.1.

Zero Cold Stores Ltd., 25a Vyner Street, E.2. Secretary: L. J. Thomas. Nominal capital: £100. Director: Philip A. Lait, 34 Gordon Road, E.4.

Water Treatment Systems for Air Conditioning

CHEMICAL research technicians of the Timken Roller Bearing Co. in the United States, have recently developed and put into effect an entirely new method of handling sulphuric acid for the control of acidity and alkalinity of water used in the company's air-conditioning systems.

The company has six water treatment towers in its air-conditioning systems that were formerly serviced and tested individually by two men every 24 hours. It was a time consuming operation and required maximum safety equipment for employees since the acid jugs had to be carried by hand to each tower located on the roofs.

Now a centrally located water treatment system has been installed at ground level. All water for these towers is currently treated at this one location and pumped to the different towers through plastic pipes. An automatic metering device controls the amount of acid injected into the water.

The new and improved method has eliminated the job of carrying acid by hand to roofs and, at the same time, has assured a better water and acid mixture through automatic metering. The present central system requires only one pump instead of six and the cost of servicing these towers was greatly reduced.

GLAND PACKINGS REFERENCE BOOK

What is believed to be one of the most comprehensive reference books on the use of gland packings that has ever been produced, has been published by Crane Packing Ltd. of Slough, Bucks. The book is designed for use as a work of reference. An equipment code which is reproduced as a book mark flap, provides an at-a-glance reference to the equipment for which each gland packing is suitable. Alongside each gland packing there are code letters to complete the reference. The main reference sections number 9: and in the sections gland packings are grouped under headings which relate to the maximum temperatures at which they can be used.

EUROVEND AGENTS APPOINTED

Eurovend Limited announce the appointment of the following agents for the selling and servicing of their refrigerated carton vending machines and their automatic straw dispenser:

South Western Automatic Co. (Bristol) Ltd., 13 Cumberland Street, St. Pauls, Bristol 2 (Cornwall, Devonshire, Somerset, Gloucestershire and South Wales); J. H. A. Swinson Ltd., 48 York Street, Belfast, Northern Ireland (Northern Ireland and Eire); Stockdales Equipment Ltd., Hunstanton, Norfolk (South Lincolnshire, Norfolk, Suffolk, Essex, Hertfordshire, Bedfordshire, Leicester, Northampton, Cambridge, Hatfield, Epping, Billericay and Leigh); Sales-Matic Limited, 44 Little Horton Lane, Bradford 5, Yorkshire (Northern Counties); Russell Automat Limited, Larbert, Stirlingshire (Scotland); Automaten Channel Islands Ltd., 11a Seaton Place, St. Helier, Jersey C.I. (Channel Islands); Autoput Limited, 12 Coleshill Street, Birmingham 4 (Warwickshire, Staffordshire, Shropshire, Herefordshire, Worcestershire, Cheshire. South of a line drawn through Birkenhead, Walleybridge, Staveley and Tuxford).

DANFOSS LECTURE

A LECTURE on Danfoss refrigeration controls was given recently to the staff of Mann Egerton Ltd., of Norwich, who are engaged on the manufacture of refrigerated and insulated vehicles. This lecture was arranged through Mr. C. Wilson, the general manager of the Electrical dept. and Mr. G. F. Leech, manager of the refrigeration dept., and was held at the Bell Hotel, Norwich.

PATENTS

APPLICATIONS RECEIVED

September 2—Maclean, J. S., P30266, Refrigerators. 6—British Oxygen Co. Ltd., Tantam, D. H., P30701, Thermal insulation ; General Motors Corporation, C30688, Refrigerators. 9—Carrier Engineering Co. Ltd., and Justham, R. R., P31212, P31213, Refrigeration systems ; Donaldson, T. H., and Cowper, G. E., P31099, Refrigeration methods ; Philco Corporation, C31142, Refrigeration apparatus. 13—Servel Inc. Miller, C. A., and Shagaloff, H. C., C31466, Ice-making apparatus. 14—Chieregath, L. Bigarella, A., C31670, Air-conditioning apparatus. 15—Philco Corporation, C31786, Refrigerating means. 16—Electrolux Ltd., C31933, Refrigerator compartment door cover. 22—Bosch G.m.h.H., R., C32524, Temperature controls. 23—Electrolux Ltd., C32732, Refrigerators, etc., shelves ; Licentia Patent-Verwaltungs-G.m.b.H., C32769, Thermo-electric refrigerating box. 26—Whirlpool Corporation, C33050, Absorption refrigerating systems. 27—Commerce Factors (G.B.) Ltd., Crabb, E., and Crabb, L., P33107, Insulating material, etc. 28—Neilsons (Ice Cream & Frozen Foods) Ltd., Powling, P. S., P33343, Frozen foods, etc., production. October 4—Wilbushewick, E., C34010, Liquid-freezing apparatus, etc.

COMPLETE SPECIFICATIONS ACCEPTED

September 28—General Electric Co., Ltd., 854,771, Refrigerator evaporators and refrigerator evaporator arrangements ; C. K. D. Praha Narodni Podnik, 854,702, Absorption cooling apparatus. October 5—Pressed Steel Co. Ltd., 855,394, Refrigeration defrosting system. October 19—Süddeutsche Kühlerfabrik J. F. Behr., 856,169, An air-conditioning appliance.

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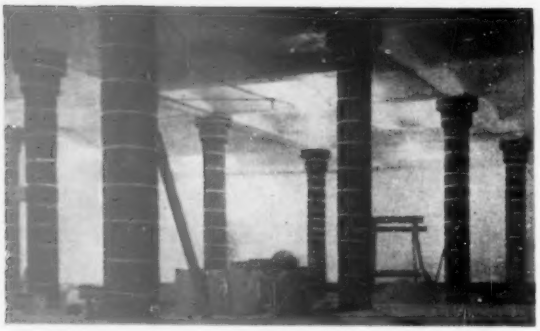

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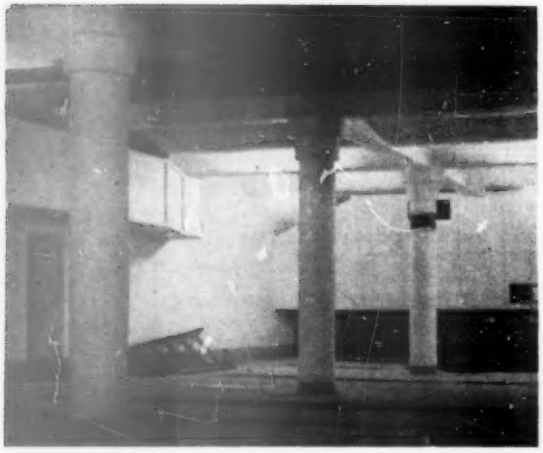

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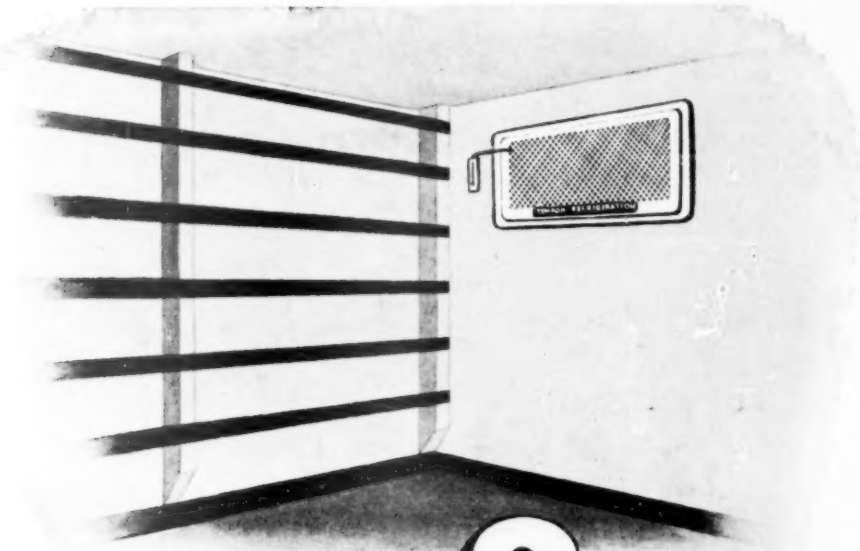

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